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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Telephone: Central 1885. Telegrams: CIRA.

The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*).

Forthcoming Events.

NOVEMBER 7.

Institute of Metals (Birmingham Local Section):—Meeting in Dudley, at 7 p.m. "Interpretation of a Photomicrograph," Paper by J. W. Jones.

NOVEMBER 10.

Institute of Metals (Sheffield Local Section):—Meeting at the University, at 7.30 p.m. "Metal Spraying," Paper by W. E. Ballard.

Institute of British Foundrymen.

NOVEMBER 10.

Middlesbrough Branch:—Meeting, at 7.45 p.m. "Routine Methods of Testing Green Sands," Paper by N. D. Ridsdale.

NOVEMBER 11.

East Midlands Branch (Lincolnshire Section):—Meeting, at 7 p.m. "The Use of Refractory Materials in the Foundry," Paper by J. J. A. Skerl.
Scottish Branch:—Meeting in Glasgow, at 4 p.m. "Cast Iron and its Physical Characteristics," Paper by Wm. McDougall.
Wales and Monmouth Branch:—Meeting in Newport, at 6.30 p.m. "Foundry Mechanisation," Paper by A. S. Beech.

The National Ironfounding Employers' Federation.

When the Institute of British Foundrymen was founded in 1904, one of its first decisions was to make THE FOUNDRY TRADE JOURNAL its official organ. About 17 years later, the Welsh Engineers' and Founders' Association thought fit to accord to us a similar honour. In 1925, the Foundry Trades' Equipment and Supplies Association was formed, and at its first meeting decided that we should be the organ for the official expression of their announcements. This year the National Ironfounding Employers' Federation decided that co-operation with us would benefit the whole ironfounding industry, as, because of its size, complexity and wide dissemination, individual approach is impossible. When the Federation was formed before the war, the foundry industry was, as we have so often been told, the Cinderella of the engineering trades. The engineers *had* to have castings, and to that extent foundries were an absolute necessity, but if anything went wrong the foundry usually had to take the blame and ultimate consequence. Prices were just what could be got—marine engines were being made for very little more than sash weights. There was no organisation anywhere—just thousands of small, separate units trying to make a living.

In an effort to obtain some sort of order out of chaos, associations of foundrymen were formed in several districts throughout England and Scotland, the main objects being to raise the foundry industry into an industry of definite national importance, and in some degree to ensure that founders obtained a reasonable price for their products. Engineers were, and are, calling continuously for greater strength and less weight—the absolute limit of perfection was being demanded in all castings. Thus, research and organisation amongst foundries became not only desirable, but absolutely necessary. Contact between foundries was maintained through the associations already formed, and it became increasingly obvious as time went on that contact between associations would be to the advantage, not only of our own trade, but to the engineering industry in general. As a result, the National Federation was formed under the title of "The National Ironfounding Employers' Federation," with its headquarters in Liverpool, and Mr. Oliver Stubbs, of Manchester, was known throughout the length and breadth of the country, as the first President. The Federation lost a valuable guiding hand when Mr. Stubbs was removed from business activities through serious illness and his ultimate death, which took place in January, 1932.

The district associations which made up the Federation were the North-East Coast, Scottish, Welsh Engineers, Irish Association, Liverpool, Manchester, Cardiff, Leeds, Bolton, Bradford, Sheffield, Keighley, Halifax and Newport, each association having their own district headquarters and continuing to function locally. The aims of the associations became those of the Federation, and since its formation in 1918 their efforts have been directed toward organising founders into a national body, and having the industry recognised as one of real national importance, which, by its very indispensability, it is. Where it can help in any way with the domestic arrangements of the trade, it does so when called upon.

The closest contact is maintained between it and the British Cast Iron Research Association. Only two years ago, when the Admiralty called for tremendous increases in the tests they required from cast iron, the Federation was solely responsible for getting the demands reduced to within reasonable limits.

To commemorate the name of the founder of the Federation, funds have been placed at the disposal of the Institute of British Foundrymen to purchase annually a gold medal for bestowing upon the leaders of foundry technological thought. To-day the Oliver Stubbs Medal is the most coveted award the industry has to offer.

During the course of its existence this action and many others of a similar nature were carried out by the Federation under the able guidance of the present chairman, Mr. James Smith, of South Shields, who took up the reins of office in January, 1930, having been instrumental in forming the Federation, and it is trusted that he will continue for many years to preside over the Federation's business affairs.

Amongst many well-known names in the foundry world, we find that the following appear from time to time as having occupied the position of Vice-Presidents:—The late Mr. F. J. Taylor (South Wales); Mr. P. H. S. Nicklin (Liverpool); Mr. Stevenson Gregg (Irish Association); Mr. P. L. Gould (South Wales); Mr. G. Pate (Scottish Association); Mr. T. W. Rudd (Irish Association); Mr. F. Firth (Sheffield), and Mr. T. P. Cargill (Scottish).

We are deeply conscious of the honour that has been accorded to us by the Association, and nothing would give us greater pleasure than to see more and more district ironfounders' associations formed and acquire representation on the Federation's Council. If any ironfounder desires to have information as to the benefits membership will confer upon his firm, he should write to Mr. J. A. Hassal at the address given in the adjoining column.

British Cast Iron Research Association.

The annual report of the Council to members of the British Cast Iron Research Association was presented at the annual general meeting in London yesterday. A report of the luncheon in connection with it, together with the address of the newly-elected President, Major F. A. Freeth, C.B.E., D.Sc., F.R.S., will appear in our columns. The report itself, however, contains several points of striking interest. Under the more prosperous conditions operating three years ago the Council undertook with the Government to raise from the industry £8,000 per annum, in order to obtain a Government grant of £3,000 per annum, having, until June, 1931, received a grant of about £5,000 per annum on an income of a similar amount. The depression prevented the larger amount being realised, and the last two years have been a financial struggle to make good the drop in grant from the original figure of approaching £5,000 to £3,000. How far this has been made good is shown by the diagram at the beginning of the report (the difference having been made good to within £400). The Government met the Association with some concessions on the amount to be obtained, and the report contains the welcome news that for the current year and next year it is prepared to contribute a grant of £3,000, subject to an industrial income being obtained of £7,000; that is, on the so-called datum of £4,000, above which all industrial income earns pound for pound. As things stood it would have been possible to earn as grant on £7,000 only £2,000, which would have caused a reduction in the work in progress. There is, therefore, an excellent possibility of obtaining for the current year a total income of some £10,000, the industry requiring to furnish new subscriptions of the order of £250 to enable this to be accomplished. This income is virtually the same as the highest previously reached when the grant was £2,000 higher than it is now.

The Council and officers are to be congratulated on the very satisfactory way in which the Association is emerging from what is likely to prove the most trying period of its history. The work steadily extends, the interest of the industry increases, the equipment is improved each year, and the accommodation is now more satisfactory than at any previous time. Compared with buildings which can be erected by rate-aided or endowed technical schools and universities it has, of course, very little to show, but time will doubtless remedy that state of affairs. We can add nothing to what we have previously repeated about the desirability of this body being supported by all eligible foundries. It is solely British and impartial; it has no other duty but to serve its subscribers, and, through them, the industry. For the benefits it can yield all British foundries are eligible, and the subscription can be regarded as little more than an insurance premium against difficulties, lack of knowledge and the advances which are perpetually being made by our competitors abroad. Skilled and impartial observers who knew of the extent of the application of science to industry in certain foreign countries would have doubted ten years ago whether this country could ever catch up. There are indications that to-day the scientific side of the industry has not only made up the leeway, but is definitely ahead, and the only danger lies in delaying the application of the discoveries to practice. This application requires time and energy, and must not be done at the expense of the research work in progress. The general support of the industry would enable this small but hard-working staff not only to realise the fullest application of their work, but to look forward to that reasonable measure of security of employment which is about the only other thing the scientific worker asks for in the way of reward.

Catalogues Received.

Colloidal Sand Binder.—The Colbond Company, of 24, Martin Lane, London, E.C.4, has sent us a leaflet setting out a reasoned and reasonable statement as to the nature and application of Colbond. Our readers should certainly apply for this leaflet, which we note is labelled October, as this development is providing, and should ensure the future provision of, much data of profound interest to the industry.

Insulating Bricks.—The Washington Chemical Company—a branch of Messrs. Turner & Newall, Limited, of Washington Station, County Durham—have sent us a 14-page well-illustrated brochure describing a line of insulating bricks. These bricks are now being marketed direct by the firm instead of through an associated company. Their main property is that of low conductivity, which is established by a combination of general and "mero" porosity, the latter being brought about by the introduction of Kieselguhr or diatomaceous earth. We seem to remember as a student that this last adjective was usually "diatomous," but looking at the word from the angle of physics, that the rendering diatomaceous is the better rendering. The thermal characteristics of the bricks—there are two varieties, "Nonpareil" and "Newparex"—have been determined by the National Physical Laboratory and the North Staffordshire Technical College, and are sufficient to convince anybody that, intelligently used, fuel bills will be saved. The setting out of the matter has been extremely well done, although personally we wish that more use had been made of the centigrade scale.

Continental Steel Cartel.

The differences between the Forges de Clabecq and the Cosibel and the former's threat to withdraw at the end of the year from the syndicate and the Continental Cartel are reported to be due to the partly unfulfilled demands of the company as regards quotas. It will be recalled that for a similar reason the company withdrew from the former Steel Cartel in 1930. Since the statement made by the Forges de Clabecq, the Steel Cartel has met at Luxemburg, and discussed the question at issue. The attitude of the Forges de Clabecq was criticised and described as being solely a means of bringing pressure on the Cartel. Owing to the general conditions it was pointed out that it was impossible to overcome the reserve of buyers, despite the formation of the Cartel, every member of which was almost equally affected by it. It was considered doubtful whether the Clabecq Company would derive any advantages if the Cartel were dissolved, and it was hoped that the company would consider the matter very carefully before taking a definite step.

Concerning the legal side of the question, it is pointed out that the Cartel and the sales organisations were formed for five years. Notice to determine the agreements may be given on June 1, 1935, but only under certain conditions, as, for instance, a change in the present constitution of the Saar after the 1935 plebiscite. It is thus considered that the Belgian group represented by the Cosibel is legally bound at least to June 1, 1935, and it is for the Cosibel to exercise influence on the Forges de Clabecq to enable the former to maintain its international obligations towards the Cartel and the selling organisations

The Belgian syndicate (Cosibel) hopes to reach an agreement with the national transforming mills in regard to quotas by granting them a rebate of 12 fcs. per ton on the official prices, so that they would only pay, for instance, 428 fcs. for billets instead of 440 fcs. These transforming mills, which mainly work for the inland market, would then entrust the sale of their products to the Cosibel.

Drawbacks of Large Cupolas.—In the "Giesserei," T. Ehrhardt points out that in large cupolas of circular cross-section high throughputs can only be obtained by employing a high blast pressure and making the cupolas disproportionately high, and suggests that both these factors may be reduced by designing the cupolas with an elliptical section.

Random Shots.

A novel experiment is shortly to be conducted in and above the Gayway Foundry at Eastbourne. Miss Nellie Snookers is to make a balloon ascent into the stratosphere. A pipeline will lead down from her balloon to one of the Gayway cupola blowers, so that the cupola blast will be tapped direct from the stratosphere. Extraordinary results are anticipated. The first tap of "Stratometal"—as the new cupola product will be called—will be used for souvenir plaques. These plaques are to be sold at the price of 100 guineas each in order to cover the heavy costs of the venture. (A "Stratometal" Subscription Department has already been formed under "Marksman's" direction.) As soon as regular production is established "Stratometal" will be used for the casting of aero-engine cylinders.

* * *

For several weeks past the Gayway staff has been busily engaged on the construction of the balloon. The gondola is made of a new aluminium alloy—Snookalumin—which is so light that the empty gondola had to be anchored to the ground to prevent its being blown away. Amongst the equipment which has been stowed aboard are a convertible bed-settee, a cocktail bar, wireless apparatus, a fortnight's provisions, a few thermometers, aneroids and the like, and all sixteen volumes of "Do's and Don'ts for Balloonists." A raid on the Gayway sand supplies has provided all the ballast necessary for the trip. The pipe-line leading down from the balloon to the foundry presented difficulties at first, but by securing 14 miles of rubber-covered flex and removing the wire by means of an ingenious device invented by Miss Snookers on the spur of the moment, the problem was solved. The gas envelope is of the patented bubble type.

* * *

Miss Snookers expects to make the ascent next week. At the moment she is "slimming" to reduce her weight to the 7 st. 12 lbs. which she has allowed for in her calculations. She does not intend to remain in the stratosphere for much more than a week. As soon as the initial ascent has proved a success, and the first tap of "Stratometal" tested and heralded as a valuable new material for high-duty applications, Miss Snookers will come down to earth, so to speak, and appoint a deputy to supervise the stratosphere end of the business. She has accordingly requested "Marksman" to insert the following advertisement.

* * *

Situation Vacant.

Wanted, young balloonist, with previous stratospheric experience, to take charge of stratosphere pipe-line. Opportunities for rising young man.—Apply, Gayway Foundry, Eastbourne.

* * *

As a good example of presence of mind in a theatre, a well-known author used to tell the story of a violinist who was sitting in a crowded theatre in New York when someone shouted "Fire!" The violinist at once left his seat, snatched a violin from a member of the orchestra and began to play a familiar melody. The audience was held spell-bound, panic was averted, and everybody was burnt to death.

Marksman.

Cast Iron Suitable for Nitrogen Hardening Nitricastiron (Centrard).*

By J. E. Hurst.

In old engineering encyclopedias there are to be found such recipes as the following:—*To harden cast iron*: Heat the article to a bright red, and quench in a mixture of 3 galls. of water, ½ pint of oil of vitriol and 2 oz. of saltpetre. Another mixture for quenching is given as: Salt water, 10 galls.; salt, 1 peck; oil of vitriol, ½ pint; saltpetre, ½ lb.; prussiate of potash, ¼ lb., and cyanide of potash, ½ lb. A method somewhat different from the previous is given as follows: Heat the article to a bright red and rub the surfaces with a mixture of equal parts of powdered prussiate of potash, saltpetre and sal-ammoniac. Allow the article to cool to red heat and quench in a mixture of 4 oz. sal-ammoniac and 2 oz. prussiate of potash per gallon of water. ("Works Manager's Handbook, 1901," by Walter S. Hutton.)

With the exception of such methods as these, the only other way of obtaining hard surfaces

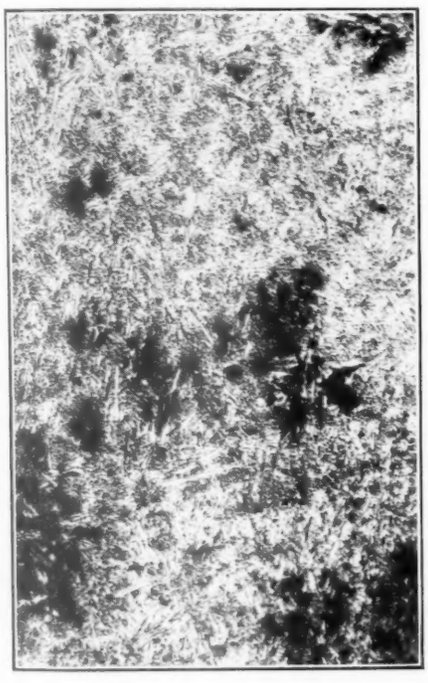

FIG. 1.—NITRICASTIRON CENTRIFUGALLY CAST. ETCHED. × 100.

on cast iron articles has been by the application of chills or by the adjustment of the chemical composition to provide a cast iron in white iron throughout. The difficulty of dealing with such castings by the ordinary processes of machining is perhaps the greatest of the limitations imposed upon the extended use of castings hardened in this manner. Consequently the recent development in the field of alloy cast irons of materials which can be surface hardened to Brinell hardnesses of 1,000—over twice the hardness of white iron—by the simple and single process of heating in dry ammonia gas at a temperature of 500 deg. C., is to be regarded as a distinct step forward in the metallurgy of cast iron. The art of producing satisfactory hardened surfaces by this nitrogen hardening process is due to the discoveries and researches of Dr. Fry (Kuppsche Monatshefte, 1923), and the extension of this process to cast iron is due to the companies with which the writer is associated. Experimental work in the production of cast iron suitable for nitrogen hardening was undertaken by them in the year 1928, and the first castings made commercially were oil-engine cylinder liners which were put into service during the month of October in that year. Since that date experiments have been continued which have resulted in the commercial perfection of the alloy cast iron and the manufacturing processes for the production of articles which can be super-hardened in this manner.

* A Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. J. Currie presiding.

Nitricastiron (Centrard) and its Properties.

The alloy cast irons suitable for nitrogen hardening have come to be known as Nitricastiron, and are manufactured and sold by the company with which the writer is connected under the Trade Mark (Centrard). Essentially the alloy cast irons contain aluminium and chromium, and in this respect are analogous to the Nitralloy steels. Typical analyses and details of the mechanical properties after various heat-treatments are given in Table I. The material described in the table has been cast by the centrifugal process, whilst that described as "sand cast" has been cast in green sand moulds. The chemical compositions given in Table I are typical of the aluminium chromium alloy cast irons suitable for nitrogen hardening.

TABLE I.

	Centri-fugal.	Sand cast.
Total carbon	2.65	2.62
Graphite	1.10	1.63
Combined carbon	1.55	0.99
Silicon	2.58	2.44
Manganese	0.61	0.60
Sulphur	0.07	0.075
Phosphorus	0.096	0.098
Chromium	1.69	1.58
Aluminium	1.43	1.37
Modulus of Elasticity, million lbs. per sq. in.		
As-cast	22.5	19.5
Annealed	23.7	19.7
Hardened and stabilised	23.0	19.2
Nitrogen hardened	23.5	20.1
Tensile Strength, Tons per sq. in.		
As-cast	24.5	19.8
Annealed	29.8	22.9
Hardened and stabilised	29.5	28.6
Nitrogen hardened	29.8	23.9
Permanent Set.		
As-cast	2.5	6.1
Nitrogen hardened	4.75	9.7
Firth Diamond Hardness Number.		
As-cast	418	340
Annealed	302	269
Hardened and stabilised	302	300
Nitrogen hardened	982	904

All the tests enumerated in Table I have been carried out on annular rings from specimens in accordance with B.S.I. Specification 5004, and all the hardness determinations with the Firth Hardometer using the Diamond Indenter and a 30 kg. load.

In examining the properties detailed in the table it is clear that the modulus of elasticity (EN value) is considerably higher at all stages of the treatment than that of ordinary centrifugally-cast material. Centrifugally-cast iron made to the requirements of the Aircraft Material Specification has an average EN value of 16 to 17 million lbs. per sq. in. The aluminium chromium alloy cast iron has a minimum of 22.5 and 19.5 millions lbs. per sq. in. in the centrifugally cast and sand cast conditions respectively. This value changes slightly in the upward direction with each treatment. The nitrogen hardened specimens have a distinctly higher EN value than the material in the as-cast condition.

The strength values have been expressed as "tensile strength" in the terms of the previously-mentioned specification. For the sake of better comparison, these values are expressed also in terms of the modulus of rupture. Centrifugally-cast material to the 4K6 specification possesses average strength values of from 18 to 22 tons per sq. in., corresponding to moduli of rupture of 29 to 32 tons per sq. in. The strength of this aluminium-chromium alloy is therefore considerably higher than that of the ordinary centrifugally cast material. The heat-treatment of the alloy is accompanied by a distinct increase in strength amounting to approximately 25 per cent. The nitrogen-hardened specimens show a slight falling-off from the strength level attained as a result of heat-treatment.

The permanent set is an arbitrary value commonly used in testing material for piston rings, cylinder liners and valve inserts, and represents the permanent change in the gap of

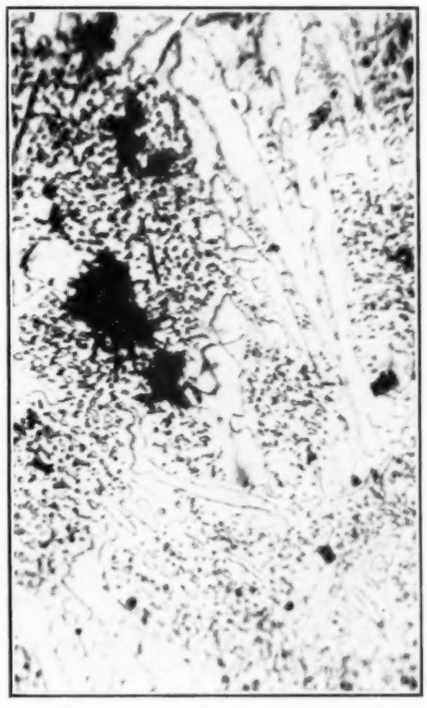

FIG. 2.—NITRICASTIRON CENTRIFUGALLY CAST, ANNEALED. ETCHED. × 750.

a gapped ring after stressing at 14 tons per sq. in. (British Standards Institution formula). The values, which increase in the hardened and stabilised condition, are definitely low. Standard centrifugally-cast material usually shows a permanent set of the order of 8 to 10 per cent. The change in hardness of the material due to the heat-treatment is clearly indicated, annealing being accompanied by a distinct softening.

The properties of the sand-cast specimens have approximately the same tendencies as those of the centrifugally-cast material. In magnitude the values of the modulus of elasticity (En value) and tensile strength are lower than those of the same material centrifugally cast; but at the same time they are distinctly higher than those of ordinary centrifugally-cast material, and quite equal to the best results obtainable with ordinary sand-cast iron for high-duty purposes. The permanent set values are higher than those of the centrifugally-cast alloy, and more nearly approach those obtained from ordinary centrifugally-cast material. In the as-cast and

annealed condition the hardness is lower, but in the hardened and stabilised condition it more nearly approaches the hardness of the same alloy centrifugally cast. The sand-cast material is somewhat less stiff and less strong than the centrifugally cast metal.

Further Properties of Nitricastiron (Centrard).

Some further physical properties may be of value. These are enumerated below:—

Specific heat between 0.12 and 0.14	
Specific gravity	7.4 approx
Coeff. of expansion. Temp. range—	
30 to 100 deg. C.	1.09×10^{-5}
100 to 200 deg. C.	1.17×10^{-5}
200 to 300 deg. C.	1.35×10^{-5}
300 to 400 deg. C.	1.5×10^{-5}

Heat-Treatment.

With the object of ensuring uniform machining qualities, castings in Nitricastiron are submitted to an annealing treatment by heating up to a temperature of 950 deg. C. and allowing to cool slowly. This alloy can be oil hardened and tempered, and under certain circumstances castings are heat-treated in this manner after annealing and rough machining by quenching in oil from

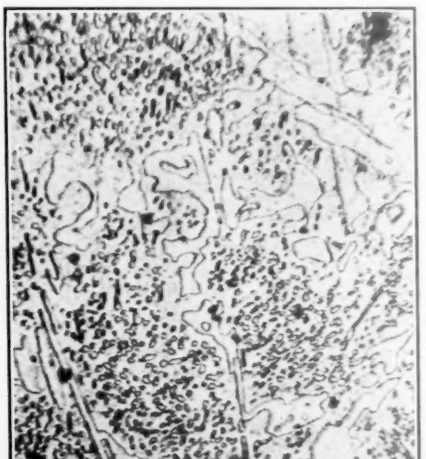

Fig. 3.—Nitricastiron Centrifugally Cast, Oil Hardened and Stabilised. Etched. × 750.

870 deg. C. and tempering at temperatures of 600 to 700 deg. C. The tempering treatment may be prolonged to provide a stabilising treatment intended to remove internal stresses and thus minimise distortion during nitrogen hardening. This oil hardening and tempering treatment has a very marked effect in producing a spherodised structure, and without doubt this structural condition ensures excellent stability in the nitrogen hardened case. Where there is any risk of distortion it is always advisable to adopt the stabilising treatment whether the oil hardening is or is not performed. The stabilising treatment should be carried out after the preliminary rough machining operations by heating to a temperature of 550 to 650 deg. C. for periods of one-half to six hours, according to the size and complexity of the casting.

Microstructure.

Figs. 1, 2 and 3 show the etched microstructures of the centrifugally-cast specimens in the as-cast, annealed and hardened and stabilised conditions, respectively. In the as-cast condition the matrix consists of very finely laminated pearlite and extremely small graphite flakes, together with substantial quantities of free carbides. In the annealed condition (Fig. 2) the pearlite carbide is seen to have coagulated in a ferrite matrix. The finely-divided graphite is more clearly visible in this micrograph, and the free carbides are somewhat less in quantity. The spherodised structure of the hardened and stabilised material is clearly shown in Fig. 3. The microstructures of the sand-cast specimens are similar to those of the centrifugally-cast specimens, with somewhat coarser graphite and a smaller amount of free carbide.

Machinability.

Annealed Nitricastiron is somewhat harder to machine than ordinary cast iron. In the annealed condition the Brinell hardness lies between 260 to 300, and it is found that this can be machined satisfactorily with Widia-tipped tools or Stellite. Annealed centrifugally-cast Nitricastiron castings were machined in the lathe at a speed of 70 ft. per min., with a depth of cut of $\frac{1}{8}$ to $\frac{3}{16}$ in. and a feed of 40 cuts per inch using Widia-tipped tools. The machining speed of sand cast Nitricastiron in the annealed condition using the same kind of lathe and tools was 90 ft. per min., with a depth of cut of $\frac{1}{8}$ to $\frac{3}{16}$ in. and a feed of 30 to 40 cuts per inch.

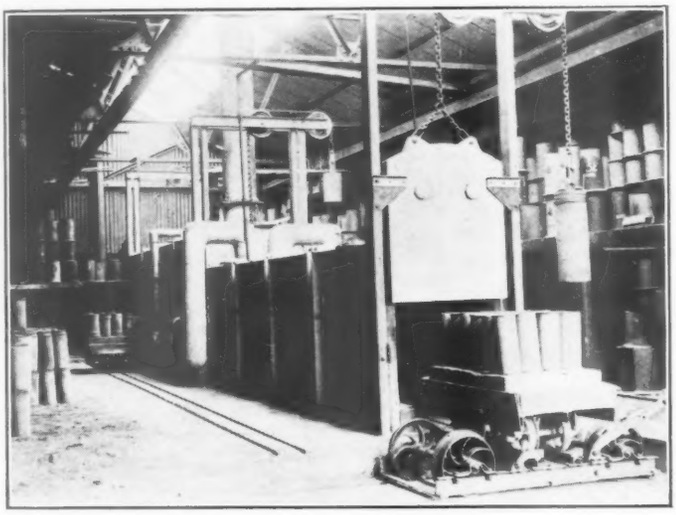

Fig. 4.—View of Continuous-Annealing Furnace for Annealing Rough Castings in Nitricastiron.

Nitrogen Hardening.

The Nitrogen Hardening Process.—In the industrial nitriding of Nitricastiron articles electrical heating is adopted. The furnace used is of the resistance type, and is provided with automatic temperature regulation. The parts to be nitrided are placed in a gas-tight box made of heat-resisting steel. The parts are placed loosely in the box without any special packing material. Individual layers can be separated by means of nickel wire netting, and care should be taken in packing the boxes to allow of a free circulation of the anhydrous ammonia gas. The box is provided with inlet and outlet tubes for the gas, and a pyrometer tube projecting into the centre of the box is used for accurate control of the temperature.

Anhydrous ammonia gas is supplied to the box from a cylinder of liquid anhydrous ammonia, and with the current of gas flowing the temperature of the box is raised to 500 deg. C. and maintained at this value plus or minus 5 deg. C. The pressure of the ammonia gas in the box is slightly above atmospheric, from $\frac{1}{2}$ to 1 in. water-gauge, and governed by a water bottle through which the exit gases are led. The length of time of the nitriding process varies from 40 to 90 hours, according to requirements. When the period of nitriding is completed the

(*Continued on page* 247.)

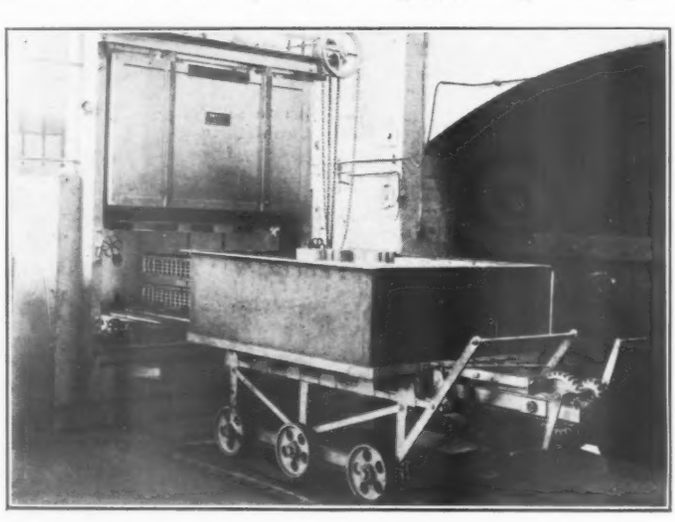

Fig. 5.—View of Nitrarding Furnace, showing Box Prior to Closing.

British Cast Iron Research Association.

TWELFTH ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1932-33.

The present report reviews progress made during the year ended June 30, 1933. An outstanding event occurred at the beginning of the year on July 6, 1932, when Lord Rutherford of Nelson, F.R.S., chairman of the Advisory Council for Scientific and Industrial Research, opened the newly-extended laboratories at headquarters. Over a hundred and fifty members and guests attended this and took part in the subsequent inspection and luncheon. The extra accommodation thereby rendered available has been of great assistance in enabling the steadily-increasing volume of work to be pursued.

For some years past the Association has desired to carry out experimental work necessitating the acquisition of a cupola furnace. This will be rendered possible by the offer of Mr. H. James Yates, Vice-President, chairman of Radiation, Limited, of funds to enable the Association to erect such a furnace. This generous provision, made by Mr. Yates through the President, Sir Harold Hartley, was the direct outcome of the speech made by Lord Rutherford at the opening of the newly-extended laboratories. The furnace will be erected during the current year at a small foundry near the laboratories, under conditions which will enable it to be operated on an experimental basis at any time, without the necessity for the Association permanently to maintain the necessary manual labour. It will greatly enhance the value of the work not only of the Melting Practice Sub-Committee, but also of the other sub-committees.

Since the close of the year under review the Association has had an opportunity of acquiring more floor space at headquarters laboratories with a view to relieving further the very considerable congestion which has retarded work during the past few years, and it is anticipated that this space will meet normal requirements for some years to come. Fuller reference is made in the body of the report.

The Annual General Meeting was held in London on November 2, 1932, when the President, Sir Harold Hartley, C.B.E., M.C., F.R.S., was unanimously re-elected. Mr. John Cameron, J.P., and Mr. H. James Yates were elected Vice-Presidents. Dr. R. S. Hutton, M.A., Goldsmiths Professor of Metallurgy at Cambridge, was elected an honorary member.

The Council takes this opportunity of thanking Sir Harold Hartley very warmly for his keen interest in and work for the Association during his period of office, which expires, in accordance with the Articles, at the Annual General Meeting on November 1, 1933. Sir Harold has won golden opinions on all sides for the interest and energy he has displayed in the Association's interests, which has on various occasions been of signal importance and value. His outstanding ability has been recognised by H.M. Government in his recent appointment as chairman of the Fuel Research Board. The Council is fortunate in being able to announce that Major F. A. Freeth, O.B.E., D.Sc., F.R.S., Vice-President of Imperial Chemical Industries, Limited, has consented to accept the office relinquished by Sir Harold Hartley. The Council feels that it is particularly appropriate that the large application of cast ferrous metals and alloys in the chemical industry should find recognition in this way.

The Council unanimously re-elected Mr. H. B. Weeks, F.I.C., as chairman, and as vice-chairmen Mr. J. T. Goodwin, M.B.E., and Mr. F. J. Cook, M.I.Mech.E. The Association is greatly indebted to these gentlemen for the assiduous and willing way in which they place their experience and time at its disposal. Five meetings of the Council and five meetings of the Research Committee have been held during the year, with an average attendance in each case of fourteen. The Publications Committee and Research Sub-Committees have held seventeen meetings with an average attendance of nine.

The Council regrets to record the death during the year of Mr. F. J. Taylor, O.B.E., J.P., who was a member of Council and a very active and sympathetic supporter of the Association since its inception. His loss is felt acutely not only in South Wales, but throughout the industry.

The work of the Research Committee covers both research work properly so called and development work, that is, work undertaken by the Association, either at headquarters or in members' works, with the specific object of assisting in the application to practice of conclusions worked out in the laboratory and in overcoming the difficulties thereby raised. It is inevitable that the growth of development work should in some measure retard the general research programme, unless there is a continual influx of members and increase in income, which admits an increased expenditure. This, however, is not to be deplored, because much of the value and strength of the work of a research association is derived from its intimate contact with the industry, and from this contact fresh inspiration with respect to the requirements of industry is continually being drawn. If this contact did not exist through the inquiries of members and development work, it would be necessary to find some means of creating it.

Research Committee.

During the year Mr. W. H. Whitehouse, A.M.Inst.C.E., M.I.Mech.E., has acted as chairman, and the organisation of the sub-committees has now reached a point at which they cover the whole of the work in progress. The work may therefore conveniently be reviewed with reference to the sub-committees themselves.

Grey Iron and Nickel and Alloy Cast Iron Sub-Committees.

The work done in respect of these two sub-committees may be conveniently considered together, since several of the matters under investigation apply equally to both fields. Of these, perhaps the most important is that of those irons termed by the Association "inoculated" irons, to which reference was made in the last report. A few years ago the average cast iron was a mixture of the metallurgical constituents ferrite and pearlite, both accompanied by flake graphite, the former resulting from the partial breakdown of the latter. These constituents, ferrite loosely resembling wrought iron, and pearlite a eutectoid steel, have different densities, thermal expansions, thermal conductivities and strengths, and, consequently, their joint presence implies a heterogeneous material. A great step forward was taken by means of closer metallurgical control in the production of an all-pearlitic iron and a further general improvement in physical properties was obtained by alloy additions. While the maximum tensile strength to be expected from the older type of iron may be taken as 15 to 18 tons per sq. in., the later step enabled irons to be produced up to about 22 tons per sq. in. To-day the industry can contemplate the production of irons approaching a tensile strength of 30 tons per sq. in., and this is actually being done by some members on a commercial scale. These figures can only be approached by the inoculation process, whereby an iron is cast virtually white and rendered grey and machinable, yet strong, by a ladle graphitiser or inoculant. Work carried out by the Association during the year has shown that such irons can be produced in ordinary commercial furnaces with various inoculants. It has also been shown that the use of nickel in the form known as F shot, or nickel and chromium, with one of these inoculants, gives improved greying properties and better strength. These inoculated irons show marked increase in resistance to shock. Examples of inoculated irons made by members were exhibited on the Association's stand at the International Foundry Trades Exhibition held in April and May, and also at the Shipping, Engineering and Machinery Exhibition held at Olympia in September, and attracted much attention. A word of caution may be expressed to prospective users. The development of these irons requires close metallurgical control of raw material, furnace equipment, melting practice, and of finished product. It must inevitably be slow, particularly in its application to large castings and to castings varying widely in section. Some designs of castings are so complex that it may only be possible to produce them in an iron of the kind now generally used having such shrinkage and contraction properties as permit a sound casting to be made in spite of the section and disposition of the various parts.

As was indicated in the last report, the inoculation process arose out of the development of the nuclear graphite theory, as a hypothesis for explaining the phenomena of superheating, to the disadvantage of which inoculation is the necessary corrective. This hypothesis, useful and important as it has been, has always presented certain difficulties, the clarification of which was essential to the further research on of the inoculation process embodied in the research programme, and during the year a great deal of painstaking work, particularly on the effects of gases on the structure of the metal, led to an important advance which, in the interests of members themselves, it is undesirable at this stage to state in detail. In due course members will be invited to test its commercial application. It appears likely to affect all sections of the industry.

The commercial development of the Association's heat-resisting irons—Silal and Nicrosilal—proceeds very satisfactorily. The number of members now licensed to manufacture has increased to thirteen, and two meetings of these, who constitute the Heat Resisting Iron Panel of the Nickel and Alloy Cast Iron Sub-Committee, have been held. During the year a report summarising the present knowledge with respect to the manufacture, properties, and applications of these alloys, superseding previous reports, has been issued, together with a report on the effects of tempering the Nicrosilals. Dr. A. L. Norbury and Mr. E. Morgan presented a Paper on these irons to the Chicago meeting of the American Foundrymen's Association in June, and an international literature in them is springing up. A representative of an Australian member, for example, has given an appreciative account of their operating results in Australia, while the Bureau of Information on Nickel published an illustrated report dealing exclusively with Nicrosilal. The general heat-resisting properties of the Silal irons has been confirmed at several centres on the Continent. The study of the aluminium-manganese-silicon cast irons, austenitic in character, has been completed and reports prepared. Molybdenum is becoming an important addition to cast iron, and work has been done during the year to clear up certain points respecting its precise influence, and a preliminary report has been prepared. The work is continuing.

The examination of a variety of members' problems on vitreous enamelling of cast iron, a process which has spread in recent years with remarkable rapidity, led the Association to hold meetings of members interested in this question and to the subsequent issue of two reports. The members concerned are regarded as forming an Enamelling Panel of the Grey Iron Sub-Committee, and comprise both light castings and engineering founders. The process involves a variety of technical difficulties as yet rather

obscure, but light is being thrown on them by the combined examination of defects and experimental work.

A report has been issued arising out of the investigation on strength and design. In a study of the deflection of transverse bars it is shown that, although the graph of total deflection with load is invariably curved, the graph of elastic deflection with load is a straight line up to fracture for a wide range of irons—brittle, tough and ductile. These three types may be roughly defined as having a low permanent set and ratio of set to total deflection, a medium permanent set and ratio of set to total deflection, and a high permanent set and high ratio of set to total deflection. These considerations have a pronounced bearing on the most appropriate way of calculating the modulus of elasticity of cast iron, a figure of great importance to designers.

Sands and Refractories Sub-Committee.

Whilst no reports of outstanding interest have been issued to members during the year, considerable progress has been made in two directions. A lengthy investigation on core sands and binders, following naturally on the earlier work on moulding sands, has been completed and will shortly be circulated as soon as some additional chemical tests required by the Sub-Committee are completed The report covers the examination of three types of core sand of varying size and shape of grain and some twenty-five binders, proprietary and otherwise, and their properties in the green and baked states. The revised and greatly enlarged issue of the report on the testing of moulding and core sands, which in its original form as Research Report No. 73 is out of print, approaches completion, and will be circulated to members during the current year. A preliminary report on the principal changes in recommended testing procedure has been issued. The greatly increased interest in testing and control of moulding and core sands throughout the industry vindicates the stress the Association has always laid on this question, experimental work on which began in 1924.

Pig-Iron Sub-Committee.

Following the publication of Research Report No. 102, covering agreed tolerances for use in the purchase of pig and refined irons to the buyers' analysis, a meeting of members, both makers and users, was held in London to discuss the whole question. Mr. P. A. Abernethy, chairman of the Pig-Iron Sub-Committee, gave the views of the makers of pig-iron, and Mr. S. H. Russell, chairman of the Grey-Iron Sub-Committee, those of the users, and a lengthy and interesting discussion took place, which is being fully considered by the Pig-Iron Sub-Committee. The preliminary addresses were circulated as Research Report No. 106.

Tests and Specifications Sub-Committee.

The main item of work done during the year has been the publication of Research Report No. 105, "Recommended Methods for the Sampling and Analysis of Cast Ferrous Metals and Alloys." This is a greatly extended form of Research Report No. 72. In the interests of the industry as a whole, the Council placed this report on sale to all those concerned with sampling and analysis, and a number of copies have been sold, both in this country and abroad. The translation and reproduction rights for the French language have been disposed of. The publication has been reviewed very favourably by the home and foreign Press, and is regarded as authoritative.

White and Chilled Iron Sub-Committee.

The size, shape and pouring conditions (chill temperature, metal temperature, etc.) of a variety of chill test-pieces have been considered during the year with a view to the adoption by the Association of recommended chill tests for grey-iron, white-iron and chilled irons. Some of these have been tried and tentative conclusions reached.

Malleable Cast Iron Sub-Committee.

During the year a report has been issued summarising the difficulties usually encountered in the cupola melting of white-heart malleable and the possible methods of overcoming them. The sub-committee has also kept very closely in touch with other work in progress by the Association which affects the production of malleable cast iron, and some experimental work on its behalf has been carried out.

Melting Practice Sub-Committee.

In the last report the installation or pending installation of twenty-three balanced-blast cupolas, yielding about 120 tons per hour, was recorded. During the year the development has been very active, in spite of the serious illness during the later part of the year of Mr. J. E. Fletcher. The total number of cupolas now installed or under construction is 41, having a total hourly tonnage of 275 tons. One of these is being installed in Australia, and members in South Africa, India and Canada also contemplate installations in the near future. Several representatives of users have given Papers embodying statements of operating results and advantages. Two of these, by Mr. H. H. Shepherd and Mr. E. Wharton, have been circulated as Bureau Reports.

During the year investigations have been carried out, with the kind co-operation of the members concerned and of the Northern Coke Research Committee, on cupola coke for two producers in both normal and balanced-blast cupolas. The object in view was to obtain under practical conditions independent and authoritative figures for melting ratios, carbon pick-up and sulphur pick-up of the cokes concerned. Some remarkable figures were obtained by the Scottish Coke Research Committee during coke tests on a cupola of the Association's design, compared with older cupolas operated by other members.

Reports have been issued during the year on relative melting costs in rotary oil and pulverised-fuel-fired furnaces, and on the oil-fired rotary furnace.

Reference has already been made to the pending installation of a cupola furnace, for want of which much of the work of the sub-committee has hitherto been held up.

Development Department.

As has been indicated above, the work of the Development Department has materially increased. In addition to the practical application of developments made in the laboratories, 643 inquiries were received from members and reported upon. The total number of visits paid during the year to members by the staff has been 482, including those for the Falkirk Laboratory mentioned below.

In connection with both research work and development work, the laboratories play an important part. The chemical laboratory has made about 2,000 estimations, in duplicate, and in the metallographical laboratory approximately 650 micro-examinations were carried out, 160 of which were recorded photographically in permanent form. In the mechanical testing laboratory about 1,000 mechanical tests, tensile, transverse, compression and impact, were made.

Scottish Laboratory.

The Foundry Technical Institute at Falkirk, the Association's Scottish laboratory, has been fully occupied with inquiries and development work arising from Scottish members, in connection with which the Superintendent, Mr. H. Cowan, B.Sc., has paid 260 visits. Although originally these inquiries mainly arose from the light-castings foundries, during the year there has been a marked increase in inquiries from the engineering foundries.

Extra-Mural Investigations.

Following the publication of Section VI of the Fourth Report of the Committee on the Heterogeneity of Steel Ingots, in which the Association co-operated with Dr. J. W. Donaldson on the thermal conductivity of ingot-mould irons, Dr. Donaldson carried out at the Director's suggestion a further investigation on material furnished by the Association. The results were given by Dr. Donaldson in a Paper to the Sheffield autumn meeting of the Iron and Steel Institute on the Thermal Conductivity of Wrought Iron, Steel, Malleable Cast Iron and Cast Iron. The results show that the thermal conductivity of a range of ferrous materials from wrought iron to 1 per cent. carbon steel varies uniformly with the amount of carbide present (as pearlite), diminishing as the pearlite increases. In a range of cast irons from malleable iron to high-silicon ferritic and austenitic irons, the best thermally conducting material is black-heart malleable, followed by white-heart malleable and the pearlitic irons. The ferritic high-silicon irons (Silals) have lower conductivity still on account of the silicon in solution, and the austenitic irons (Nicrosilals, etc.) are least conducting of all. The uniformity of the results makes it possible reasonably to predict the thermal conductivity of any cast iron or steel from the composition and structure.

The application of ferritic, pearlitic and austenitic cast irons for heat-resisting service has directed attention to their creep properties, which have been only examined by the Association as far as very simple apparatus permits. The Committee of the Department of Scientific and Industrial Research on the Behaviour of Materials at High Temperatures has undertaken to make creep tests on irons supplied through the Association by various members. Five irons are under examination in this way, a normal engineering iron, a nickel-chromium cast iron, a high-silicon cast iron (Silal) and two austenitic cast irons (Niresist and Nicrosilal).

Education Committee.

Foundry Education.

The Association is represented on the Advisory Committee for Foundry Practice and Science of the City and Guilds of London Institute, the Craft Certificate scheme in connection with which is making admirable progress. The Director, in conjunction with the Secretary of the Institute of British Foundrymen, has been invited to act as examiner to the City and Guilds for this examination.

Laboratory Training.

During the year several apprentices nominated by members completed a period of training in the laboratories and have now all returned to their respective works. During the long vacation of 1932 two students from the University of Birmingham were received in the laboratories for a vacation course, and a number of visits were received from representatives of members desiring to examine the tchnique adopted.

Staff Training.

The whole of the junior members of the scientific staff of the Association who do not have university qualifications are proceeding towards professional certificates of the various technical institutions, either chemical or engineering, and all are making satisfactory progress.

Employment.

The Director has been able to make recommendations to members desiring to employ suitable young men when such are known to be available in the industry.

Study Course.

During the year a scheme was discussed and subsequently approved by the Council for holding a Study Course at headquarters. This was planned with the object of making a review or survey of the work of the Association for the past few years and of linking it up with existing practical knowledge and metallurgical experience. This course was planned for October 12-14, and no less than one hundred and seventy registered their intention of attending.

The course was by unanimous agreement pronounced very successful, and those attending have been invited to express an opinion on it

with a view to such modifications as experience may suggest in determining any future meetings, their character and frequency. The three mornings were occupied with lectures, frequently illustrated with lantern slides and specimens, on some fourteen selected subjects, taken by seven of the senior members of the staff. The lectures were held at the recently-opened James Watt Memorial Institute. The afternoons were devoted to demonstrations in mechanical testing, physical testing, microscopic examination, chemical analysis, foundry testing, sands and refractories testing, all held in the laboratories. About a hundred and twenty members took advantage of an opportunity to inspect a balanced blast cupola in operation. The Association is greatly indebted to the directors of John Thompson (Wolverhampton), Limited, for their courtesy in permitting this and for their hospitality.

Higher Grade Education.

During the year the Council's attention was drawn to proposals for the establishment at Sheffield of a university course in founding leading to a degree. The matter has been referred to the Education Committee for report, and is now under consideration.

Acknowledgments.

The Council is indebted to several members for their kindness in voluntarily increasing subscriptions, including Blakey's Boot Protectors, Limited, Shotts Iron Company, Limited, and the Wallsend Slipway & Engineering Company, Limited. The Council also desires to express its particular appreciation of the support of the Armourers' and Brasiers' Company. The broad outlook of this ancient guild and its support of all deserving causes in metallurgical education and research are very encouraging. The directors of the Sheepbridge Stokes Centrifugal Castings Company, Limited, have kindly presented a dry wear testing machine originally designed by Mr. J. E. Hurst, and Mr. Walter Higgs, of Higgs Motors, Limited, an electric motor. To the Barrow Hematite Steel Company, Limited, Bradley & Foster, Limited, and the Staveley Coal and Iron Company, Limited, thanks are due for gifts of pig and refined iron.

Cast Iron Suitable for Nitrogen Hardening Nitricastiron (Centrard).

(*Continued from page* 244.)

furnace is allowed to cool down quickly to 370 deg. C. with the current of ammonia passing. The box is then taken out of the furnace and the parts removed as soon as they are cool enough to handle.

Control of the process is exercised through the extent of dissociation of the ammonia. The ammonia dissociates to a certain extent into nitrogen and hydrogen, according to the reaction:—

$$2\ NH_3 \rightleftharpoons 2N + 3H_2$$

The exit gases leaving the furnace consist therefore of hydrogen, nitrogen and undissociated ammonia. The ammonia gas is very soluble in water, and advantage of this is taken in determining the extent of dissociation. A special form of pipette has been designed for this purpose. A value of 30 per cent. ammonia dissociated is found to be the most desirable condition. The exit gases are periodically tested throughout the operation. If the extent of dissociation is greater than 30 per cent. the gas flow should be increased, whilst if it is less than 30 per cent. the rate of flow should be decreased. Figs. 4, 5 and 6 show typical views of the Nitrarding installation. Fig. 4 shows a view of the continuous annealing furnace for the treatment of the rough castings prior to machining. A view of the Nitrarding furnace and box is given in Fig. 5, whilst the exit end dissociation tester are shown in Fig. 6.

(*To be concluded.*)

Book Reviews.

Moulding Sand and Moulding Materials, by Karl Schiel. Published by Wilhelm Knapp, Verlagsbuchhandlung, Halle (Saale), Germany. Price, 8.80 mks. on paper cover and 10 mks. bound.

This book forms No. 18 of a series of some twenty volumes on foundry practice published under the general editorship of Hubert Hermanns, and a further half-dozen volumes are in the course of preparation. The present volume, which contains 155 pages with 87 figures, deals with the occurrence, properties, preparation and testing of moulding sands and auxiliary materials. German sands are dealt with only, and passing reference is made to American and Continental supplies. No mention is made of British sand deposits, testing methods or research work. An interesting account is given of the formation of sand deposits. Methods of testing new sand deposits are outlined covering such properties as refractoriness, clay content, chemical composition, etc., due emphasis being laid on the colloidal properties of the bonding medium. A series of practical tests for the foundryman who does not possess a laboratory are also indicated. The author recommends a classification of sands according to the grain size and clay content similar to the American method. The standard specification sheet for sand supplies proposed by the German Foundrymen's Association incorporates details of the permeability, bond strength, grain size, refractoriness and chemical analysis.

The preparation of facing sand is discussed and recommendations made regarding coal dust quality and quantity. The development of a "unit sand" for central sand-treatment foundries and mechanised foundries is mentioned. Core sands and the wide field of core binders are given full consideration. A whole series of tests on oil-sand core binders are reproduced, and an appendix gives an account of some recent research on the strengths obtained with various oil binders. Facing materials, such as charcoal, plumbago and blacking, are described.

With regard to sand tests, the importance of moisture content is emphasised, and both laboratory drying methods and the electrical resistivity method of determining moisture content are described. For testing permeability the American method is given prominence, and several other methods on similar lines are described. The Reitmeister method which is largely used in Germany determines the amount of air in litres) which will pass through a column of sand 1 cm.^{2} in cross section and 1 cm. high at a pressure difference of 0.4 atmosphere. One simple method described consists in measuring the permeability of a column of sand to water as an indication of the gas permeability. A most interesting permeability test devised by Prof. Piwowarsky consists in measuring the gas pressure developed a short distance back from the face of a mould when the metal is cast. The importance of ramming on the test results is mentioned, but beyond reference to the American standard ram no other methods of ramming the test-pieces for the various permeability tests are described. The methods of determining the strength of moulding sands which are described include compression, shock, tensile, shear and transverse tests. A series of tables and curves are reproduced from German research work to illustrate the relationship between moisture content, permeability, strength, grain size, clay content, etc.

Reference is made to the ramming density obtained in actual moulds and methods of taking test cores from rammed moulds are described. The ramming densities found to give best results in service are between 1.45 and 1.75 gm./cm.^{3} The occurrence of abundant supplies of natural moulding sands in Germany has not encouraged the development of synthetic sands as is also the case in Great Britain, but the possibilities of such sands are mentioned by the author.

On the whole, the book contains much useful information on the constitution of moulding sands and on the methods of testing sands and core materials. There are apparently no existing standardised methods for making the various tests, but from the accumulated data of the various investigators it should be possible to arrive at some generally acceptable methods.

F. K. N.

Notes from I.B.F. Branches.

Middlesbrough Branch.—The more optimistic tone in industry upon Tees-side was reflected in the Presidential Address to the members of the Middlesbrough Branch of the Institute of British Foundrymen on October 13.

Addressing an audience of about 150 members, their wives and friends, MR. JOHN E. MERCER, said that while there had been a depression lasting a long time in trade generally, he did think there was a brighter atmosphere in the foundries and more men were being employed in that industry at the moment than had been for a very long period previously. Jobbing- and heavy-foundry work might be short, but the motor trade and the building or light castings were providing work for a very large number of men which outweighed the numbers unemployed in the other sections of the foundries.

Mr. Mercer went on to say there was plenty of scope in the foundry for highly-trained youths and men to occupy the executive positions and to try and eliminate some of the troubles the making of castings gave to all. They in the foundries were working in a wide field and had to compete under severe economic conditions.

To-day was the age of specialisation, and the more intricate design of castings had made it necessary for very close application of the art of thinking.

The President went on to refer to the importance of good training among students, and said they had in the Constantine Technical College a training centre of which they should not only be proud, but of which they should take every advantage. The opportunity of taking the foundry courses there had been somewhat neglected in the past, possibly through parents having no knowledge of the wide field there was in this direction for training men for executive positions. He hoped that in the coming year there would be a greater realisation of the fine opportunities for training that were available at this college.

Referring to the Branch, the President said that considering there had been a lack of orders to keep foundries employed, the membership, which now numbered 70, had been well maintained. A very instructive programme of Papers had been arranged for the winter session. The Institute had formed a technical committee to deal with various phases of the foundry, and the published work of these committees should be in the hands of every sincere foundryman.

Giving a welcome to Sir Guy and Lady Wrightson, who were among those present, Mr. Mercer said that Sir Guy was a thoroughly practical foundryman and understood all the trials and troubles of the foundry. He had sufficient faith in the foundry to put his two sons there.

A social evening followed the brief business portion of the evening, and all present had a very enjoyable time. Among those present, included representatives of the Admiralty, Lloyd's Register of Shipping, the Board of Trade and representatives of the Constantine Technical College. Mr. F. A. Harper, the hon. secretary of the Branch, was the M.C. for a whist drive, the prize winners included:—Ladies: (1) Mrs. J. E. Ramsey, (2) Mrs. C. A. Dickenson; Sealed: Mrs. S. P. Thorpe; Gentlemen: (1) Mr. W. Siddle, (2) Mr. T. D. Richards; and Sealed: Mr. G. F. Husband.

XUM

Prospects of the Foundry Industry.

VIEWS OF SHEFFIELD METALLURGISTS.

At the conclusion of his presidential address, Mr. Kitching invited discussion. This was opened by Mr. J. E. Hurst, who proposed a vote of thanks to Mr. Kitching, and said that he himself did not need to be reminded of the difficulties surrounding prospects in the foundry trade. He had just returned from the Shipping and Machinery Exhibition, and was amazed to find that almost every firm was engaged in the manufacture of small high-speed Diesel engines. The amount of cast iron in those Diesel engines was extraordinarily small. Everything except the cylinder liner and probably the fuel-pump body of a Diesel engine was made of steel. If he himself was not of an optimistic temperament, the picture presented of the foundry trade to-day would be very disconcerting, but it was a fact that nature provided dispensations for all the trials and ills that beset life, and he believed that there was a dispensation in view for all the ills that existed in the iron-foundry trades. He looked with a great deal of interest to the developments taking place in alloy cast irons. The developments that had taken place over the last five or seven years in alloy cast iron were perfectly amazing, and the properties that could be usefully developed in the new alloys available even to-day were wonderful. Mr. Kitching had referred to decorative castings. At one time cast iron was the main medium in which decorative works were executed. As managing director of the foundries of Newton Chambers, Mr. Kitching was fully aware that round about 1793 and onwards a considerable trade was done in the foundries in the production of flower vases and all sorts of ornamental castings. That type of work had disappeared, and there had been substituted, as far as metals were concerned, non-ferrous metals which had come into fashion probably by virtue of their corrosion-resisting properties. He felt that fashion was in the process of changing again. Steel founders were producing stainless ferrous materials, and were establishing a fashion for a different type of colouring in decorative metal work from that of the non-ferrous material. It was to be hoped that cast iron would follow quickly on the heels of the stainless-steel activities with developments in decorative castings. On this subject he was speaking recently to an Italian friend of his who had a foundry and was well known to all British foundrymen. He referred to Dr. Vanzetti. A section of Dr. Vanzetti's foundry was being devoted to the production of decorative castings—flower boxes, ash trays and so on. Some of the articles thus produced were really beautiful. Then Mr. Kitching had mentioned the question of cast-iron crankshafts and the activity of the Americans in this direction. He (Mr. Hurst) believed that experimental work in cast-iron crankshafts had developed to a high level in the United States and was already being contemplated in England. Again, for the production of such articles as crankshafts, the Americans were relying on the mechanical and physical properties of the new alloy cast irons available. It appeared from all the theoretical investigations that had been made that the properties were of such a character as to enable cast-iron crankshafts and camshafts to be used with safety. As one section of the industry appeared to be languishing, at the same time another section of the industry appeared to be developing. He extended a welcome to Mr. Kitching as their new President. Mr. Kitching was well known to all of them as an enthusiastic foundryman, and he was sure that Mr. Kitching would do all within his power to keep the foundry trade going to its fullest possible extent. Moreover, as they all know, Mr. Kitching was deeply interested in the Institute of British Foundrymen and the Sheffield Branch. They were all looking forward to a very happy year under his presidency.

Mr. A. Whiteley seconded the vote of thanks and said that Mr. Kitching's address afforded them ample material for reflection as to where the developments in the industry were leading.

Replying to points raised by Mr. Hurst, the President said that undoubtedly the question of alloys in cast iron was a very important one. They had some extraordinary results with alloys, but the unfortunate part was that although alloyed cast iron could be used for a great many more purposes the cost of alloys prevented certain sorts of cast iron from being a commercial proposition. That was, he thought, one of the greatest difficulties. There was no doubt that they had to compete against welded steel that had been used in other directions, but it was a fact that no matter how many welded-steel articles they might use there was nothing like cast iron for wear, whereas steel would disappear in a few years.

Retiring Age.

Mr. A. Roebuck said they had expected Mr. Kitching to call a spade a spade and he had done so. He felt a little on the defensive already as one who was more closely associated with steel, but perhaps the occasion was not suitable to discuss its relative advantages. So far as a retiring age, alluded to by Mr. Kitching, was concerned, he (Mr. Roebuck) was opposed to a definite age for retirement. He had for many years been in close touch with a large number of men. Obviously men were not all of one type and development. He could not subscribe to the policy of a retiring age for people of different types. He could point to craftsmen of 60 years of age who were 100 per cent. efficient. Why should such men retire? It was wrong to say that all efficient men of 60 or 65 should retire. Experience still counted. Then, in regard to price maintenance, he took the view that some such system had to be considered. Under present conditions its advantages outweighed the disadvantages. The President had also referred in his address to welding. That was a very important subject. There had been marked developments in welding during the last few years, and foundrymen had to recognise them. They had to keep abreast of the times. The fabrication of castings must now be considered a part of good foundry practice. It was still a fact that in some of the special high-nickel-chromium steels the casting would give better service than the wrought or forged material.

Mr. C. D. Pollard, as the retiring President, extended his best wishes to Mr. Kitching for a happy year of office. He said he felt like Mr. Roebuck, and that he was almost on the defensive from the steel-casting production side. A great deal had been said and written about the alloying of cast iron. He felt that the steel-casting producers were not saying as much as they should do on the question of alloy-steel castings. In the case of his own particular firm, their output was composed practically of 70-80 per cent. of alloy-steel castings, and in that sphere they were making every endeavour towards an inroad into the forging side of machinery construction. It was a very difficult job to put in castings where there had already been forgings, but it was not impossible, as they were finding out. He thought that, so far as alloy-steel castings were concerned, the metallurgists of Sheffield in particular were to be congratulated, but they could not be congratulated upon advertising the fact as they ought to do. He would advocate that they advertise their alloy-steel castings as much as the alloy-iron castings were being advertised. At the present time welded structures were taking the place of steel castings to a great extent, but providing progress were made in the producing of alloy-steel castings, this competition would be somewhat minimised. The cost of production and maintenance of prices had been enlarged upon by previous speakers, and he would like to emphasise the necessity of impressing upon buyers the inadvisability of pressing for cheap prices and encouraging steel-foundry people to undercut one another. Our duty is really to impress upon buyers the fact that, if they encouraged producers to offer their articles at lower prices than their competitors, the producers were either going to lose money on the jobs (which is doubtful) or were going to take something out of the production. In the production of steel castings vital issues must be attended to. Attention must be given to detail. Unless they were dealing with a light design, they must have a high percentage of discard, such as feeders, buckets, etc., and with the cost of steel in the ladle what it was to-day, the discard necessarily made the casting a high-priced article. Further than this, if a foundryman issues steel castings for service that have not had proper heat-treatment, he was not doing justice to himself, and was sending castings out of his shop that were in an unsatisfactory condition. Sometimes customers told him that they would not buy from his firm because their deliveries were late compared with the deliveries of other firms. He had been acquainted with cases of people offering to deliver important steel castings within two or three days of receipt of orders, but he defied any steel-foundry people to produce such steel castings of comparatively large dimensions in two or three days. A casting that was to be subjected to serious service must have the necessary heat-treatment. This was one side of the business, he thought, that as foundry people they did not enlarge upon sufficiently. They had buyers with experience in iron-foundry work wanting them to supply steel castings at very little more cost, and as quickly, as when asking for iron castings. In fairness to themselves, they could not accept orders of that sort, and should rather be without the work. Recently discussions had been going on in America regarding the quality of steel castings made under mass-production conditions. He was of the opinion that the mass-produced steel castings of America were not up to the standard of finish and cleanliness of English steel castings. Some people advocated the adoption of as much mass production in England as possible in regard to steel castings, but he thought they should consider very carefully as to whether they could afford to do so in view of the demand. They had to have mass production of certain types of steel castings in that they could make them on machines, etc., but the question was as to whether they should adopt mass production on the lines that a number of buyers encouraged.

Price Agreements.

Mr. S. Leetch said that he was in agreement with many points of Mr. Kitching's Paper, but reference had to be made to the fact that last year the demand for steel castings was only 25 per cent. of the normal output of steel foundries in this country. They had been discussing the question of price-cutting. It was being urged that they should all agree upon the same prices. The question was, however, were they all honest men? It seemed to him that if a price was agreed upon, some people would adopt a back-door method and get orders, and those who loyally kept to the agreed price lost the work. He was inclined to the view that the tendency of the demand to be so much below the production of the country might mean that a great many people would have to go out of the industry before the remaining people could get a fair price and make steel castings at a profit.

XUM

Co-ordinating Phases of Foundry Activities.

PRESIDENTIAL ADDRESS TO SCOTTISH I.B.F. BRANCH.

The opening meeting of session was held in the Royal Technical College, Glasgow, on October 14. Mr. Dudley H. Campbell, retiring President, occupied the chair, and there was a very large attendance of members and visitors.

The CHAIRMAN, after extending a welcome to all present and expressing the hope that the visitors present would find the proceedings so interesting that they would all become members of the Institute, said that he had now come to the end of his term of office, and he wished to thank all who had so nobly supported him during his tenure of office, especially the council and secretary, who had done so much to lighten his work. He had enjoyed his term much more even than he anticipated when he took office. He had now to introduce the new President (Mr. Currie) to the chair and to bespeak for him the same cordial support and assistance as had been accorded to himself. Mr. Currie was well known to them as a metallurgist. He was the first purely steel-foundry representative they had had as President, and he thought that was a happy coincidence in view of the programme of the present session, when they were to have a steel-castings symposium. Mr. Currie would be exceptionally well qualified to deal with such a meeting. He had pleasure in introducing Mr. Currie and asking him to take the chair.

MR. J. CURRIE said that he had to thank them for the hearty welcome they had given to him and also for the high honour bestowed upon him in electing him as Branch-President. He appreciated the honour very much, but realised that in view of his limited experience of such work he might have difficulty in following in the footsteps of the previous Presidents, who had been chairmen of a high order. He asked all the members to co-operate with him in making the branch a success, they by large attendances, and he for his part would spare no efforts to uphold and increase the prestige of the branch.

His next duty was to ask them to accord a hearty vote of thanks to Mr. Campbell for his services during the past session. He had given ungrudging service and had conducted the business of the branch in a most satisfactory manner. They parted with Mr. Campbell with a certain feeling of regret, but they hoped to still have the pleasure of his company at their meetings and his assistance in the future.

Mr. J. Currie then delivered his address, in the course of which he said:—

Mr. Campbell and Gentlemen,—One of the first duties of a President is the presentation of his address, and whilst one has a very wide field to choose from, it is usual to endeavour to give some message of encouragement for the year which will help all classes of our members in these difficult times to carry on to further success and achievements.

Obviously there was no panacea for the trials and troubles which every day affect those connected with the foundry, but having asked for co-operation in making the coming session a successful one, that co-operation should be taken as a text and if found possible and worth while, kept well in sight, for if this were done, things would go ever so much smoother and better for all, not only in the foundry industry, but in the whole country, or perhaps even the whole world. There is no doubt but that the stress of economic conditions experienced during the last few years has forced people to realise that every country depends more or less on the prosperity and success of every other country; that the interest of all countries in sound credit and confidence in stable government are not only common to all of them, but are amongst the vital conditions of their welfare. Many countries of the world are like the destitute unemployed, gradually sinking and becoming daily more demoralised.

A strong will and effort is necessary to give any chance to those countries and people, and this effort must not be the effort of any one country but the task of all the nations of the world; for only by giving up conflicting interests and by adapting a better spirit of international co-operation can they increase their confidence and so recapture the lost trade which will give the prosperity of which the whole world stands so much in need.

Examples of Co-operation.

The first example is co-operation between similar firms or between firms producing the same articles. Such associations do exist and certainly do much good, but they could do better if they would get their members agreed to procure the abolition of price-cutting, which, after all, benefits nobody except the buyer of the goods and, very often, results in poor workmanship and danger of bankruptcy to the weaker firms. Such co-operation need not involve the formation of rings or combines, but rather that standardised methods of costing should be utilised to arrive at an economic and profitable price.

The unification of practices of the trade might well be another point which could be brought about by mutual agreement, as there are so many points regarding patterns, storage, insurance, machining defective castings and consequential damages which require definite settlement. Again, the setting up of a strong representative council to consider and to express with authority the opinions of the trade regarding regulations on silicosis, dust extraction, or any other of the Home Office edicts. Such associations do exist, but there is either not enough of them or they are not doing their work efficiently. Otherwise there would not be the cut-throat competition in existence which results in ridiculous prices being offered and taken for all classes of castings.

Then there would be more co-operation between customer and founder. This should be possible, and it would enable the founder, especially in the jobbing foundry, to obtain clearer and more concise information regarding the purpose for which his castings are required, and would, therefore, put him in a better position to offer suggestions regarding improvements either as to design or material. Collaboration in the method of making the patterns would be possible, and thus the production of better and cheaper castings with increased production and delivery would result. Founders could then take a personal interest in their customers and give real service, whilst customers on their part could assist by giving any information regarding previous failures of similar types of castings, and also help by stating their true delivery requirements. Very often buyers specify and insist on delivery dates which they do not really require, and thus sometimes unknowingly add expense to the job and tend to cause slipshod work to be despatched, simply in order to keep up to promise of delivery.

Customers buying from fresh sources of supply could point out to founders where difficulties were likely to occur and where defects were previously found. This would not only help the customer immediately to get good castings, but save the founder much time and expense and obviate experimenting in order to find the best way possible to produce a sound and economic casting.

If these remarks are true as regards customer and founder, they are also true and applicable to the co-operation between founder and inspecting engineers, who are very often the sole connection between buyer and producer. Such men should have common sense and judgment well tempered with experience, be willing to join with the founder in producing the finished product in the quickest, best and most economical way. This can be achieved by passing on any information they may have regarding the requirements, past failures and general difficulties likely to be encountered. The inspector would then have a much better chance of obtaining a sound casting produced in a reasonable time, able to meet the specified requirements. A general unification of specifications would be another step in the right direction, and, whilst not wishing to criticise unduly, it seems ridiculous that at present different inspecting bodies should specify physical properties of widely diverse values for the same type of casting. The result is that castings for a certain class may be rejected under one specification and be accepted as excellent castings under the other. The failure of castings after being put into service is a matter which often leads to much discussion, and here is one most important point where the interchange of ideas between engineer, inspector and founder is very necessary, for if no apparent defect is found in the casting, other reasons for failure must be suspected. It is clear that the best of materials cannot be expected to function correctly if the design of the casting is bad, and, further, that neither correct design nor sound material will resist incorrect or bad handling, so that it is of paramount importance that the co-operation of all interested parties should be secured if such failures are to be prevented.

The Internal Aspect of the Foundry.

If progress is to be made here, it is necessary to have harmony, and close co-operation must exist between the heads of the firm, directors and staff. Their constant endeavour should be to keep the spirit of friendship alive and to make all concerned feel that they have a live interest in the firm, that good work means not only satisfaction to themselves, but also to their customers; whilst on the other hand, bad or slipshod workmanship is a disgrace, and acts as a hindrance to themselves and the company.

Directors should realise that when success is achieved credit must be given, and encouragement meted out to all concerned. Again, the staff should understand that if through good workmanship and management the firm should succeed, they will also prosper. These remarks should also be applied to the spirit existing between the firm and staff on the one hand and workmen and apprentices on the other. Foremen should realise that they have not any monopoly of brains, and that suggestions well worth while may emanate from even the most backward of workers. If after a preliminary consideration such suggestions are found worthy of further investigation, they should be duly credited to the proper source. Honesty and fair play must be the slogan in all dealings between firm, staff and workers, and the workers on their part will realise the difficulties that exist in procuring remunerative orders, and make every effort to save material and time in every way possible.

Welfare schemes are in existence in many large works, but in the small foundries such grandiose refinements are not possible, due to the heavy upkeep charges, but due consideration for the personal safety of the worker should be made without going to the excesses which are sometimes observed. Considering how improvements can be made or harmonious work produced by more intimate and friendly working between members of the same staff, compare the relationship between the office or clerical side and the works or practical side.

In most works there is much room for co-operation between these two parties. A closer and clearer realisation of the difficulties of both parties should be the first aim, and if such were done the office staff would understand that founding is not a straightforward job, that faulty castings are to be expected even in the best regulated shops, and that especially in jobbing foundries estimated times cannot always be fulfilled with complete accuracy, and that, when making promise of delivery, some latitude

should be allowed for the hundred-and-one possible difficulties which may arise. The works personnel could do their bit to help the smooth running of the business by keeping a close eye on material and giving timely warning of requirements, for only by so doing can the firm's buyer purchase in the best market and benefit by the rise or fall in price of the various materials required. Costing and estimating to be accurate must have the wholehearted support of the works and office staff, as only by close co-operation can correct overheads and other details be allocated to their proper source. By such means keener prices may be quoted and more work brought to the firm.

Technical Co-operation.

The most important and most essential part of the works, as far as co-operation is concerned, is that of the drawing office, patternshop and foundry, for by close collaboration between these departments much useful work can be accomplished and much unremunerative work obviated. In the drawing office or the designing department there is the birthplace of many of the foundry troubles in the shape of bad or impossible designs, quick change of section, etc., all of which would die a premature death if the draughtsman, patternmaker and moulder were brought together to discuss the proposed drawings and to point out the difficulties peculiar to their own production. The result would most likely be a modification of the design, which would be a compromise agreeable to all parties. Machining allowances could be fixed allowing those concerned with the finished casting an opportunity to produce a casting as free as possible from the various defects usually found.

The patternshop and foundry, instead of criticising each other, should realise that "United they stand, divided they fall," and that only by exchange of ideas and friendly discussion can the production of good, cheap castings—so necessary at the present time—be effected. Methods of making patterns, splitting and provision of coreboxes, sweeps, etc., must be studied in advance and decided upon in perfect harmony, otherwise failure and wasted time are the inevitable results. Patterns must be constructed to withstand fair wear and tear, but moulders must also have it impressed upon them that patterns must be protected and carefully treated, otherwise the castings produced will have a tendency to be distorted or in some other way not correspond to necessary dimensions. Coreboxes should be made whenever possible to eliminate extra work in moulding and should also be clearly marked and made as nearly as possible foolproof to prevent misplacement in the finished mould. Patternmakers should find what kind of cores are going to be made, as very often a box that is suitable for an ordinary sand core is quite unsuitable for oil-sand work.

When perfect harmony exists in the foregoing departments, the only other fly in the ointment, as far as the foreman moulder is concerned, is the chemist or metallurgist, when and where such exists. Much useful work and thought goes for nothing when these two members of a staff do not pull together, and it is often found that there is a continual fight to see who is to be saddled with the responsibility of defective castings. Usually the training of the parties concerned is widely different, and the viewpoints taken up are directly opposed. Such a position is impossible and entirely unnecessary. Each individual concerned should realise that by mutual understanding and discussion many of the difficulties encountered would disappear and that much useful information could be exchanged which would result in harmonious working and in increased efficiency all round. The old cries of bad metal or bad moulds would disappear, and the true cause of the failure would be discovered and acknowledged, and obviated in future productions. The moulder would benefit from the technical knowledge received regarding the composition and properties of the metal and sands he uses, and without doubt would be able to utilise the knowledge obtained to produce better work. With the introduction of special metals, synthetic sands, special core oils, etc., the domain of the foundry has become increasingly technical, so that co-operation with the laboratory is to the moulder's advantage, and, if properly accepted and used, would do much to alleviate the onerous position of the foundry foreman.

Finally, there is the co-operation which may seem to many superfluous, but without which much time and money can be wasted or, on the contrary, saved, that is, the working together of the foundry and fettling shop. This is primarily to the foundry foreman's advantage, but also indirectly benefits the fettler. Mistakes made in the foundry can be noted at an early date and the remedy applied, if possible, to the successive castings. Bad castings are also observed and steps taken to obviate trouble, and last, but not least, the fettler, when working in harmony, can do much to salvage defective castings, and very often offer suggestions which may be to the good of all concerned, for, if correctly understood, any improvement in the foundry floor is later reflected in the dressing shop.

Co-operation for Sales.

Having exhausted nearly all the personnel of the general foundry, one should not leave it without bringing in the salesmen, whose work is of vital importance to the well-being of the company. The salesman should have the confidence and the co-operation of the works staff, as only in this way will he be in a position to give prospective customers information regarding his wares and give accurate information regarding deliveries and quality and advice on the proper material for any proposition which may be put up to him. Thus it may be said that the co-operative effort of all the officials of the firm, the sales department and the heads of the various foundry departments is necessary to procure the best results, which, after all, mean profit. The sceptic may say that all this is very nice for the large works, but what about the little place? This is quite a reasonable question, but it may be pointed out that co-operation in the smaller foundry is equally necessary and should be easier than in the big foundry, because in many instances the officials of the firm also are the salesmen and departmental heads.

Leaving the foundry and going further afield, it is worth while to study where co-operation can improve individual knowledge, personal friendships and generally give one a new interest in one's work. The sphere referred to is none other than the Institute.

Its motto is science hand in hand with labour, a motto obviously well worth while. The Institute provides scope for much useful work, but, as in every other case, if an individual expects to get the best out of it he must put his best into it. The Institute must get the best men to give Papers and have discussions from practical men not hampered by convention or prejudice but free in every way, for only by so doing can the maximum benefit be derived. The social side should also be developed, as there is no doubt but that much good can come from private talks between members, and it is suggested as a slogan, "Get to know each other." Find out who one's neighbour is and where he works and what he does. Try to get to know the members engaged in the same line of foundry work, and any member who is anxious to meet any other member could be introduced by members of Council, as they feel sure that such an introduction would be welcomed. This would be one step in the right direction and would make the institution of much more value to the individual member.

Turning from the individual to the Institute as a whole, it can also co-operate. Moreover, this is already being done, but it can go further in this direction. For instance, there could be still closer co-operation between the Institute and other technical societies. It has already had several joint meetings, but as so many foundry problems are contingent on the problems of the engineers, shipbuilders and locomotive engineers, etc., why cannot everybody concerned get closer together on more occasions and discuss their problems together? Already considerable strides have been made in this direction and societies have, perhaps, gone part of the way in issuing the joint syllabus under the guidance of the Association of Secretaries of Technical Societies, but not until they get under the same roof can we understand and appreciate their different points of view and at the same time show the other societies the difficulties of the foundrymen. Quite apart from questions of this kind, however, there is need not only for co-operation between British technical societies but for international co-ordination and co-operation on many questions regarding foundrywork. Such questions as sand control and synthetic sand are universal, and, looking at it from a more scientific viewpoint, the properties of metal at high temperatures is a point on which much more knowledge is desirable. There is no doubt that progress has been made in this direction by engineers which has left the metallurgist and foundrymen far behind, and therefore only by increasing and pooling our knowledge can foundrymen provide the materials which are now so necessary for the economic and high efficiency level reached by engineers. It would therefore seem that international co-operation on lines such as these would offer many advantages and would improve the trade of British foundries. Some steps have certainly been taken in these directions by means of Exchange Papers and international conferences, but still more and still closer co-operation on these lines is urgently wanted.

The work of the Institute in collaborating with and advising educational bodies is well known, and in this respect the Scottish Branch has always been to the forefront, and may it long continue to be there, for there is no doubt that it can only be by such actions that the apprentice problem will be solved and the country as well as the industry be enabled in the years to come to reap the benefit in the shape of highly-skilled and trained workers who will be able in their turn to keep the foundry industry in its rightful place in engineering.

Much could be said regarding ways and means of co-operation in this direction, but it can be said that the Institute is working on the right lines and if continued it will produce the good results its members are all striving for.

Votes of Thanks.

Mr. N. McManus, M.B.E., said that they had listened to a very good address by the President, brimful of common sense and good advice, and he thought that it was a good augury for the coming session. Fortunately or unfortunately, presidential addresses were not open for discussion, but he thought that there could be little in the way of adverse criticism of the address they had just heard. It was a good augury for the session, and if each one of them took the points most applicable to them and applied the ideas to their own particular conditions, the results would be of great benefit. He had pleasure in asking them to accord to the President a hearty vote of thanks for his inspiring address.

Mr. H. W. Winterton, in seconding, said they would all agree that the new President's address put them in mind of some of the treatises which they used to read. He thought during the time he listened to the address of Dr. Smiles' Self Help. He considered they might apply the test to themselves and endeavour to carry out some of the suggestions made by the President.

Mr. Currie, in expressing thanks for the vote and close attention with which they had listened to him, said that it was an initial effort on his part, and hoped his critics would make allowance on that account.

Early Roll-Founding.

Mr. Harold E. Cookson, in his Presidential Address to the South Staffordshire Iron and Steel Institute, dealt with the development of rolls and rolling mills from the earliest times. Part I of his address covered the rolling mill section, and Part II, which we reproduce *in extenso*, with the actual founding of rolls.

The year 1700 is the earliest reference to chilled rolls the author has found, when an advertisement of a London ironfounder, which mentioned rolls for flatting iron, etc., and metal so hard that a file cannot touch it, or so soft to admit of being turned. Mr. Rhys Jenkins, to whom the author is indebted for the above information, states that in R. R. Angerstein's "Resa genom England" (1755), Angerstein says that the rolls used at Pontypool came from Bristol. The account of the type of mould used is not clear, but the rolls were cast with a head, and from a reverberatory furnace, and were turned by means of a square bit of steel, the edges of which are wedged tightly on the roll.

The year 1753 is the next reference to their manufacture, and in January and July, Isaac Wilkinson, of Wilson House, in the parish of Cartwell, in the County Palatine, Lancaster, took out patents concerning the manufacture of a new sort of cast "metallick rolls" for crushing, flattening, bruising, and grinding of malt, oats, bran, and any kind of grain and sugar cane.

In April, 1758, Isaac Wilkinson, of Barsham Furnace, in the parish of Wrexham, in the County of Denbigh, took out another patent, No. 723, "a new method for the casting of guns or cannons, fire-engine cylinders, pipes and sugar rolls, in dried sand in iron boxes made for the purpose, whereby the said guns, cylinders, pipes and rolls will be made and cast in a much more near compleat exact and useful, as well as cheap and expeditious manner than any method hitherto known or made use of." The description reads as follows:—

"The outside of the cope of the mould or moulds in which the rolls, guns, cylinders and pipes are intended to be cast must be made of sand, mixed with a little horse, or cow, dung, or any other thing to make it porous. This sand is made well and then rammed up, and the pattern being first put in iron boxes made for that purpose of two . . . or any number of parts or pieces as the nature of the instrument to be cast requires; then the boxes are to be taken asunder into pieces and the pattern taken out; then the sand in the boxes is dried in a stove; and when dry it must be blacked or faced with some wett charcoal dust or black lead or any other mixture or thing to make the same come off or part from the metal when cast. The insides of cores of all the different instruments above mentioned are made with iron bars either hollow or full of holes; or solid and traced or fluted, and if the core is large it may be made of bricks walled and the bars of iron bricks are to be wrapped round with ropes made of straw or hay to take the air off, and must then be covered with a proper thickness of sand, and then dried or blacked as before directed; and then the moulds are put together and the instruments cast."

Mr. H. W. Dickenson in his work, "John Wilkinson, Ironmaster," informs us that in 1761, John William Wilkinson took over Isaac Wilkinson's works, completely reorganised them under the name of The New Bersham Company, where they made calendar rolls, malt mill, and sugar rolls. About twenty-five years afterwards this works was described as being the most considerable one of its kind in Europe. This works was about four miles from Wrexham. It seems difficult to establish definitely when and where the first chilled roll was made in view of the data cited of the advertisement in 1700, but chilled rolls were being manufactured by The Bristol Ironfoundry in 1764. How long this firm was in existence the author has been unable to ascertain.

In an article entitled "Notes on the Technical Development of the Tinplate Industry," in Mr. Brooke's brochure there is an account of a Swedish visitor to South Wales sometime before 1755, and information leads one to believe the rolls used were chilled. They were 14 in. long and 11 in. to 12 in. dia.

Obviously grain rolls were used originally for rolling sheets and tinplates, for it will be remembered that sheets were rolled prior to 1700, and mention has been made of wrought iron rolls.

Stone Rollers.

According to Mr. E. H. Brooke, a stone roll can be seen, and also a stone pinion, at a place called Pontyfelin, Pontypool, and through the courtesy of Messrs. Baldwins, Limited, the author took photographs. This roll lies half buried in a field near to the Panteg Steel Works. The diameter is about 48 in. The stone pinion is in fairly good condition. Tradition says this roll was used for rolling iron.

In 1784 Richard Nevill, of Llanelly, were established, but the author has been unable to find out when they commenced to manufacture rolls. According to old records obtained from Mr. Rhys Jenkins, they were certainly making chilled rolls in 1851, and by 1875 they were reputed to be the largest roll makers in South Wales. The foundry was owned by Yalding and Davies before Richard Nevill took over.

There are records of rolls being made in 1796 at Neath Abbey, both soft and hard, and at this time there was also a roll foundry at Hayle, in Cornwall, but no data are available. Referring once again to "Notes on the Technical Development of the Tinplate Industry," in 1798, rolls had increased in size to 18 in. long and 14 in. dia., and the mill consisted of two pairs of rolls. The mill housings were as in 1755, each composed of a pair of wrought iron uprights threaded through a pillow block, and a cap block of cast iron. Both top and bottom rolls were driven and pinions mounted in separate housings.

There is a record in the City of Birmingham Library of a patent for chilled rolls, No. 3601, of 1812, by John Bunn. (L. Beck in his book "Geschichte des Eisens" refers to him as Burn.) They were made thus: The roll bodies were cast in heavy iron chill moulds, while the two necks were moulded in loam. Mr. J. W. Hall holds the view also that it is John Bunn and not Burn, and that his patent relates to the working up of old hoop iron, in which the faggot is passed through "case-hardened rolls," and that Beck did not know the difference between case-hardened wrought iron rolls and chilled cast iron rolls. Case-hardened rolls had been in use for some considerable time.

In 1814 there is a record of a visit of two Germans to this country, named Eckardt and Krigen, who came to study, amongst other things, the manufacture of tinplate and chilled iron rolls. They came to Birmingham and Bilston, and visited Claridge and North of Bilston. These two Germans would probably be the same referred to in Part I as visiting South Wales. The author has been unable to find when Claridge and North were established, but they were certainly making rolls of all classes, and rolling mill machinery, in 1860-1865. They closed down in 1875.

The Staffordshire Roll Makers.

Whilst it is obvious from the foregoing, Staffordshire was not the birthplace of the roll making industry, it certainly, from the following records, can claim to have become the home of the roll trade. Griffiths in his "Guide to the Iron Trade of Great Britain," 1873, definitely states that at that time the majority of rolls were made in Staffordshire, and indeed sixty years later there are still more roll makers in the County of Staffordshire than in any other County in Great Britain. It is to be regretted that in several instances it has been impossible to obtain much information with reference to the early history of the roll making concerns. It cannot be said who is the oldest existing Staffordshire roll maker to-day, but probably Messrs. Thomas Perry & Sons, Limited, of Bilston, can claim that title, having been founded in 1806, but when they actually commenced to make rolls cannot be stated, though they certainly made large rolls in 1853. This firm were obviously very closely followed by Messrs. Johnson's Iron & Steel Company, Limited.

In 1823 John and Samuel Roberts established a roll foundry in West Bromwich. Possibly it was this firm that became T. & J. Roberts a year later. They closed down early in the twentieth century. W. Millington & Company, Summer Hill Iron Works, Tipton, were roll makers at this time, but have been out of existence now for many years.

Chilled Rolls.

In 1825 William Church took out Patent No. 5084. This patent refers to the method of casting a roll with a "case hardened" (chilled) surface. The iron mould is surrounded by a jacket through which water flows to cool the mould. The patent really refers to the method of casting by exhausting the air from the mould and forcing the metal into the mould from the bottom. The case hardened surface is not the subject of the patent, although it is the first mention of such in the patents examined, but it is evidently only a reference to a type of roll then in common use.

It is difficult to say when Johnson's Iron & Steel Company first entered the roll trade, certainly it was in the very early days, for in 1838 definite records exist of makes of both chilled and grain rolls for universal use.

Probably the original owners of the ironworks were Keys and Bissell. Johnson's then took over. Later Johnson joined hands with a man named Cranage, this would be about 1838, and this partnership lasted for some time. Later the firm became known as J. T. & W. E. Johnson, and finally took the title it holds at the present time.

In 1840 Taylor Bros. were established at Gold's Green, West Bromwich, and were actively engaged in the roll trade. Mr. Charles Akrill took over the works in 1870. The present company, known as C. Akrill & Company, Limited, took over early in the twentieth century. Again it has been impossible to trace when the first chilled roll was made, but certainly they were making what were some of the largest chilled rolls then made, about 1870.

A patent granted to Moses Poole, No. 11810, in 1847, deals with castings of cast metal which may be made hard by running the metal into thin metallic moulds cooled externally by solid liquid or gaseous refrigerating substances. Sand is used to form portions of the mould for parts of the castings when such parts are to be soft.

There are records that in 1850 Krupp was engaged in the manufacture of rolls for the gold and silversmiths, and in 1854 the Victoria Roll Foundry was founded by Guest and Cranage. Cranage was at one time connected with the Hall End Works with Mr. Johnson, and Mr. Guest had been associated with Mr. Cranage at these works, too. Undoubtedly they commenced the manufacture of rolls soon after their establishment. Later the firm was carried on by Guest and Bridge, this was about 1860, and later by Guest and Silvester, in about 1872. A short time later the title was changed to Guest Bros. & Company, and towards the end of the nineteenth century the title became as it is to-day, Josiah Guest & Sons.

Patent No. 1388, of 1855, shows Sir Henry Bessemer was interested in the roll trade, for

he refers therein to rolls or cylinders to be cast "in molten steel," or a mixture of steel and pig, solid rolls being cast with the axles entire, whilst patent No. 885 of 1856 clearly indicates that broken necks were a trouble in those days, and an interesting description of the method of burning on necks is given in this patent. In fact, from other records inspected, twenty years later, this kind of failure was prevalent, and was doubtless caused by the small diameter of the necks.

In 1857 the works of R. B. Tennent, Limited, Coatbridge, Scotland, were established. Here again it is to be regretted that no data was available as to when they commenced the manufacture of rolls. The prevention of roll breakages has been the goal of many ideas. Patents have been granted for various methods of making rolls with steel centres having chilled outer coverings cast or shrunk on. In Patent No. 2317/1857, it is claimed to prevent breakages by applying "hot water (the hotter the better) to the necks of the rolls, whereby they are kept as near as possible at the temperature of the body, and only about one-twentieth of the usual lubricating material required." This is almost directly opposite to the present common practice, doubtless accounted for in some measure by the greatly increased outputs.

In 1860 Marshall, Watson & Moorwood were making rolls in Sheffield at this time. Mr. Moorwood, of the present Sheffield firm of John Moorwood, Limited, was connected with them, his father taking a prominent part in the management. This firm made most of the armour-plate rolls for the Sheffield firms, but from records inspected Staffordshire makers also sent rolls to this area. Mr. Moorwood has given me some measurements of the rolls his firm made. They were:—

For John Brown's works: 96 in. by 36 in., weighing about 18 tons, and for Cammells, 90 in. by 34 in., weighing about 15 tons. These were grain rolls, and it would be about 1879 or 1880.

In 1861 Mr. John Player took over the Clydach Foundry, the date of erection being unknown, and it was probably some time later that he commenced the manufacture of rolls. Some time after 1868 George and Edward Thornycroft purchased the Swan Garden Roll Foundry at Wolverhampton, which is now owned by John Lysaght, Limited. This works was probably at one time owned by John Wilkinson. It is difficult to say, however, when they commenced to make rolls.

About this time Ward and Vipond, later known as W. M. Ward & Company, Great Bridge, near West Bromwich, and Williams & Sons, Morriston, were making rolls, but the author has been unable to trace any further data, neither can he say when they ceased operations. He also regrets he has been unable to obtain accurate data as to the commencement of the manufacture of rolls by Messrs. Taylor & Farley. He believes, however, it would be in the region of 1870, because one of the Taylors from whom Mr. Charles Akrill took over at Gold's Green, joined Mr. Farley to commence the manufacture of rolls.

In 1870 the author's grandfather, E. Cookson, was making rolls at the Audnam Foundry, Stourbridge. The Glanmore Foundry Company in South Wales commenced the manufacture of rolls, and according to Mr. Rees made chilled rolls in 1871. Reference to Bayliss, Jones & Bayliss is made in Griffith's Book published in 1873, but again it is difficult to say when they entered the roll trade. However, it was about the beginning of the twentieth century.

"Stainless-Invar."—According to "Nature," K. Honda has developed a new alloy named "Stainless-Invar," which contains 36.5 per cent. Fe, 54.5 per cent. Co and 9 per cent. Cr. This alloy has a very low coefficient of thermal expansion and has an exceptional resistance to corrosion.

I.B.F. Elects New Members.

At a meeting of the General Council, held at the Royal Station Hotel, York, last Saturday, the following were admitted to the various grades of membership.

As Members.

A. Aitken, managing director, Burton Foundry Company, Limited; G. S. Bell, engineer and metallurgist, A. J. Kidston & Parker, Limited, London; Y. Fujii, B.Sc., metallurgist, Imperial Japanese Navy, London; James Benson, foundry manager, Caledonian Foundry Company, Greenock; W. T. Mitchell, ironfounder, Grahamston Iron Company, Limited, Falkirk; R. G. Russell, manufacturer, Russell Manufacturing Company Proprietary, Limited, Melbourne; C. S. Whitfield, foundry manager, Bengal Iron Company, Limited, India.

Members.

S. C. Bilsby, engineer and foundry machinery merchant, Birmingham; A. D. G. McBean, pig-iron and coke merchant, A. McBean & Son, Wolverhampton; A. Proud, foundry manager, Modern Foundries, Limited, Halifax; J. J. Sheehan, assistant foundry superintendent, Austin Motor Company, Limited, Birmingham.

Associate Members.

J. N. Blackwood, moulder, Dawson & Downie, Limited, Clydebank; H. Cross, foreman, Poplar Foundry, Limited, Preston; A. Cunningham, foreman moulder, Grangemouth Iron Company, Limited; F. S. Duerden, foreman moulder, Poplar foundry, Limited, Preston; T. D. Richards, works manager, W. Richards & Sons, Limited, Britannia Foundry, Middlesbrough; A. W. Smoker, foundry foreman, Dewrance & Company, 165, Great Dover Street, London; R. P. Fisher, clerk, R. & A. Main, Limited, Falkirk; N. Foster, assistant foundry manager, J. Brown & Sons, Middlesbrough; J. L. Handley, patternmaker, Peter Brotherhood, Limited, Peterborough; V. G. Heyes, mechanical engineer, Mysore Gold Mining Company, Limited; C. Higgins, iron moulder, Yorkshire Repetition Castings Company; R. F. Holland, foundry student, J. Stone & Company, Limited, Deptford; E. Owen, metallurgist, C. Walmsley & Company; J. H. M. Postlethwaite, engineer apprentice, Leyland Motors, Limited; H. Seed, foreman fitter, Poplar Foundry, Longridge; W. Walker, iron moulder, Forth & Clyde & Sunnyside Iron Company; R. M. Watters, assistant foreman (enamel dept.), R. & A. Main, Limited; R. Williamson, foreman moulder, Melville Brodie Engineering Company.

As Associate Members.

J. Forrester, foreman coremaker; F. W. Holder, foundry foreman, Alfred Herbert, Limited, Coventry.

Associates.

F. W. Mountain, engineer's patternmaker, Steel Foundry of Leyland Motors, Limited; Wm. Wright, moulder, Ashmore, Benson & Pease & Company, Limited, Thornaby.

New Coated Abrasives.—Increased efficiency ranging from 20 to 60 per cent. is claimed for coated abrasives made by a new electro-coating process. In this the abrasive particles are brought into an electrostatic field which first polarises them by induction, causing them to stand upright. It also rearranges them in close pattern, each particle at the same distance from its neighbours, and then hurls them like arrows into the glued paper, embedding them firmly, points up and evenly dispersed. Unusually uniform grinding and abrading action is attributed to the uniform coating thus produced. The maximum number of cutting edges and tips per total number of particles and per square inch of sandpaper is presented to the work, since all particles are set upright. These coated abrasives are manufactured in all standard grit numbers from fine to coarse, in coatings of garnet, silicon-carbide and aluminum-oxide; on backings of paper, cloth or combination; and in discs, belts, rolls, sheets and moulded forms.—"Iron Age."

Developments at Cardiff Steelworks.

CONTEMPLATED OUTPUT OF 300,000 TONS YEARLY.

Plans of development which provide for the manufacture of 300,000 tons of steel at the Cardiff works of the British (Guest Keen Baldwins) Iron & Steel Company, Limited, are outlined in a letter addressed by Sir John Field Beale, chairman of the company, to the Lord Mayor of Cardiff.

Sir John Beale's letter states that it has proved possible to make quicker progress with the proposal to reopen the Cardiff works of the company than seemed likely earlier in the year, and he suggests that a meeting with representatives of the Corporation to discuss the company's proposals should take place at the earliest possible date. Sir John Beale adds that in the preparation of the plans his company had the advantage of the advice and assistance of the Bankers' Industrial Development Company, and while their final report had not yet been received, it was hoped that the proposals would have their general approval and support.

Imported Semi-Finished Steel.

The letter adds that three years ago, when the British (Guest Keen Baldwins) Company was formed, Free Trade had made it impossible to contemplate capital expenditure for the manufacture of billets and sheet bars in South Wales, although these commodities were formerly an important part of the output of the works at Ebbw Vale and Dowlais. Importations of billets and bars into the ports of Cardiff and Newport totalled 207,000 tons in 1929, 287,000 tons in 1930, 342,000 tons in 1931, and 302,000 tons in 1932, in spite of the extraordinarily bad condition of the general trade of the country in the later years. The plans for the new works at Cardiff are designed to remedy this position, the letter states. They will provide for the manufacture of about 300,000 tons a year of billets and sheet bars, in the first instance, with provision for an increased output if the demand should warrant it. With this volume of production, modern mills and lay-out enabling molten iron to be used in the manufacture of steel, as well as the great natural advantages of the site at Cardiff and the use of a proportion of the plant already existing there, it can be shown to be possible to produce billets and bars at a cost which should bear favourable comparison with other steelworks, and enable the output to be sold at a price which should prove satisfactory to users and give a reasonable return on the large capital outlay. In the belief that the scheme is not only practical, but urgently necessary, in the interest of Cardiff itself and the whole of South Wales, the board have already given instructions for the remodelling of a second blast furnace and for a start to be made in clearing the site.

Tariff Uncertainty.

The letter proceeds:—"My directors ask me to remind you of the very wide effect of this new scheme in dealing with the problem of employment during construction and afterwards. In addition to the men it is estimated as likely to be directly and permanently employed, numbering about 1,500, more men will be at work at the docks, limestone quarries, iron-ore mines, coalfields, electric-generating stations and in transport. But I must also mention the one over-riding difficulty that, although the new works will take some two years to construct, the protective duties on which the whole scheme is based have barely a year to run. While it is necessary to mention this awkward circumstance, my colleagues and I cannot regard it as likely to cause serious delay. The country's future prosperity and security depend to so great an extent on the maintenance of an active and efficient steel trade that it is impossible to believe that industry can be left for long in a position which precludes contracts exceeding 12 months' duration, while capital expenditure cannot be justified on a plan based on a shorter outlook than 20 years or so."

The Lord Mayor of Cardiff replied to the letter that he would be glad to arrange for a deputation of the City Council to meet the directors of the company.

Rate of Expansion of Alloy Steels.—According to the "U.S. Bureau of Standards Journal of Research," W. A. Tucker and S. E. Sinclair have studied the rate of expansion and structural changes of 15 alloys with 0.03 and 1 per cent. C, 3 to 55 per cent. Cr and 1 to 75 per cent. Ni, under different loads at 870 deg. The maximum effect was found with alloys of 30 to 40 per cent. Fe. and 30 to 35 per cent. of each Ni and Cr.

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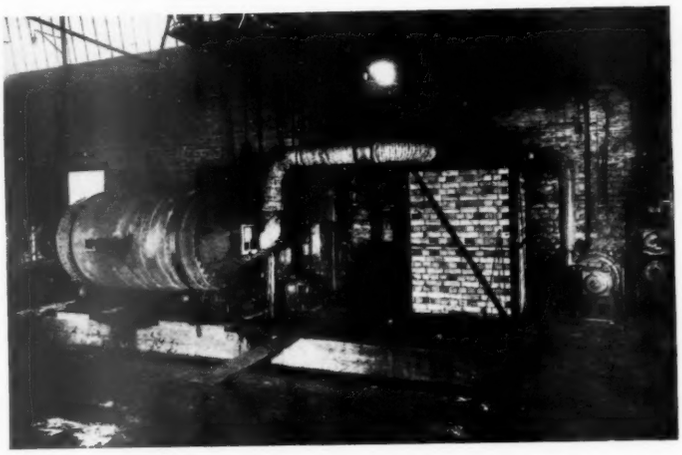

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This Week's News in Brief.

Trade Talk.

During the past three months the employees of Ardeer Factory (Nobels), Stevenston, Ayrshire, have contributed £179 to infirmaries and other charitable institutions.

Glasgow Corporation has accepted the tender of the Stanton Ironworks Company, Limited, near Nottingham, for the supply of 199 tons of cast-iron water pipes, amounting to £1,565.

Newcastle-upon-Tyne City Council has decided to convert the Palace of Arts, one of the few remaining buildings of the North-East Coast Exhibition of 1929, into an industrial museum.

At the last meeting of the Wishaw Dean of Guild Court a petition presented by Messrs. J. & W. Syme for permission to make an extension to their blacksmiths' shop and forge was granted.

British machinery is fitted in the new electrical generating station for the Vatican, which was inaugurated by the Pope last week. The Pope received the British engineers of the firm of Babcock & Wilcox, Limited, and congratulated them on their work.

Messrs. Richard Dunston, Limited, have launched from their shipyard at Thorne a Diesel-engined barge designed for the Leeds Corporation, who will use it for the transport of coal from West Yorkshire collieries to their electricity works in Leeds.

It is understood that Messrs. Denny Bros. & Company, Limited, Dumbarton, are not only to build the new ferry vessels for the services across the Firth of Forth from Queensferry, but they will also operate the service. This scheme is an entirely new departure for a shipbuilding firm, and will be watched with interest by other Scottish shipbuilders.

An order for an auxiliary Bermudian ketch has been placed with Messrs. James Adams & Sons, Limited, Gourock. The vessel is similar to that ordered a week or two ago, and both vessels have been designed by Mr. W. G. M'Bryde, naval architect, Glasgow. The boat will be fitted with two Gleniffer petrol-paraffin engines designed to give a cruising speed of 8 knots.

The foundry of Messrs. Moses M'Culloch & Company, Limited, in Gallowgate, Glasgow, was the scene of an exciting fire. The fire occurred in the roof and top flat of a three-storey building used as a pattern store. A passage only 2 ft. wide separates the building from a tenement. Workers operating a forge furnace in a one-storey building attached to the foundry building carried on quietly whilst the firemen were fighting the flames 30 ft. above them. Though the loss is estimated at £5,000, arrangements have been made to carry on business as usual.

A further indication of the improving prices for scrap material is the reported sale of five cargo vessels belonging to the Federal Steam Navigation Company to foreign shipbreakers at prices averaging a little more than £1 per ton. The vessels range from 6,800 to 8,400 tons gross. Three have been sold to Japanese shipbreakers and two to Italian breakers. Another sale reported recently is that of the Red Star liner "Lapland" to Japanese shipbreakers for a sum in the region of £30,000. This ship, of 18,694 tons gross, was built in 1908.

An order has been received by the Chinese Government Purchasing Commission in London for 4,000 tons of 60-lb. rails, to cover about 50 miles of the section of the Canton-Hankow Railway to be built out of the Boxer Fund; also for constructional machinery, some small bridges, and 40 goods trucks and passenger cars. The total order is for £150,000. Other orders are to follow as construction proceeds. Instructions have also been received from Nanking to obtain tenders in England for four ships of about 2,000 tons each, with which the Chinese Government intends to develop the coastal trade.

It is stated that but for the holding up of the trade agreement between this country and Russia, several large orders would have been well in operation at the Clydebridge Steel Works of Messrs. Colvilles, Limited. The Russian Government is anxious, it is understood, to place several large orders with the Lanarkshire steel firms, and there is talk of an order for 7,000 tons of steel having already been negotiated. Unfortunately, work on the orders cannot be started because the trade agreement has not yet been signed by representatives of both countries, who differ on the question of the right of the British Government to demand the insertion of a clause to the effect that the British Government can place an embargo upon the Russian imports without notice. The difficulty is that, unless the agreement is reached quickly, these orders cannot be executed this winter, as the Baltic will be closed owing to winter conditions.

Mr. Walter Runciman, President of the Board of Trade, and other guests of the Master Cutler (Mr. C. J. Walsh), who attended the Cutlers' Feast in Sheffield, paid a visit on October 19 to the Steel, Peech & Tozer Works of the United Steel Companies, Limited. Speaking at a luncheon which followed the inspection of the works, Mr. W. Benton Jones said that the older works, which supplied shipbuilding, railway and general engineering material, were not at present very fully occupied. The more interesting side was the Templeborough works, where they made billets, bars and strip. Those works were put down during and after the war, and with the full anticipation that in future the users of steel in this country would always buy British steel as long as it was available. Unfortunately, that anticipation was not fulfilled. But the position had changed recently, and now buyers were willing and anxious to buy British steel before they bought foreign steel. The works were now nearly fully occupied, and they afforded a real example of what could be done if employment was provided, and of how necessary it was to maintain conditions under which works of that character could be fully occupied. Owners of works could do a great deal by making them economical and efficient, and by pursuing markets with energy, but there were some factors which they could not overcome. Those were factors which were controlled by national policy. Those who directed industry and those who directed national policy should be in the closest touch with one another. They did not want the Government to be their tutors; but they did want to be able to discuss their problems with them on the same level. Therefore they did ask that they should be able to be in the closest possible touch with those who directed national policy, on account of the reactions which it had upon industry, so that they might keep them informed of what, in their view, industry required, in order to make the country prosperous.

New Companies.

John Rolland & Company, Limited.—Ironmasters, founders and workers, etc. Capital £1,000. Directors: Mrs. S. K. Rolland, 20, Embankment Gardens, London, S.W.; H. S. Nicholson and F. H. Seager.

Stainless Steel & Holloware, Limited.—Stainless steel, tube and hollow-ware, and cutlery and steel manufacturers, etc. Capital £6,000. Subscriber: E. P. Annely, 6, Hunstone Avenue, Norton, Sheffield, 8.

H. F. Spencer & Company, Limited.—To take over the business of iron, steel and metal merchants and stockholders carried on at the Mitre Works, Eagle Street, Wolverhampton, and Darkhouse Lane, Coseley, Staffs, as H. F. Spencer & Company, and to enter into a trading agreement with Ebbw Vale Steel, Iron & Coal Company, Limited. Capital £50,000. Director: H. F. Spencer.

Contracts Open.

Buenos Aires, November 14.—Parts for locomotives and rolling stock, for the Argentine State Railways. The Department of Overseas Trade. (Reference G.Y. 13,072.)

Somerford, November 8.—4,900 yds. of 3-in. spun iron water main, with fittings, for the Congleton Rural District Council. Mr. H. Ferrand, clerk to the Council, Offices, Crewe Road, Sandbach. (Fee £2 2s., returnable.)

Company Reports.

General Refractories, Limited.—Interim dividend of 2 per cent.

Herbert Morris, Limited.—Net profit, £29,901; brought in, £41,773; dividend of 10 per cent. on the ordinary shares; to reserve, £10,000; carried forward, £24,674.

Personal.

Mr. Herbert Smith has joined the board of W. & T. Avery, Limited, machines manufacturers, engineers, etc.

As a result of the examinations in pattern-making and foundry practice and science, organised by the City and Guilds of London Institute, Mr. J. G. Rees, of Sheffield Foundry Trades Society, was awarded the silver medal in the final examination on pattern-making, and Mr. B. R. Pearson, of the Technical College, Coventry, was awarded the bronze medal in the intermediate. Mr. T. W. Trayhern, of Birmingham, and Mr. G. T. Hampton, of the County Technical College, Wednesbury, were awarded bronze medals in the examination on foundry practice.

Dr. D. H. Ingall has been appointed Principal of the Borough Polytechnic, in succession to Mr. J. W. Bispham, who has been promoted to Assistant Education Officer (Technology) under the London County Council. Dr. Ingall, who is a D.Sc. of the University of Birmingham and a fellow of the Institute of Chemistry and the Institute of Physics, was formerly metallurgist to the Patent Shaft and Axletree Company, Limited, Wednesbury. From 1919 to 1921 he was senior lecturer in the Department of Metallurgy, University of Birmingham; from 1921 to 1928 Principal and head of the Department of Metallurgy, the Staffordshire County Technical College, Wednesbury; and from 1928 to 1931 Principal of the Constantine Technical College, Middlesbrough. Since 1931 he has been assistant director and research manager of the British Non-Ferrous Metals Research Association. He has been President of the Staffordshire Iron and Steel Institute and chairman of the Birmingham Metallurgical Societies Co-ordinating Committee.

Wills.

Thouless, H. J., director and secretary of Messrs. Barnards, Limited, Norfolk Ironworks, Norwich	£8,432
Chalmers, Ebenezer, of Edinburgh, founder of Messrs. E. Chalmers & Company, Limited, metal merchants	£39,483
Griffiths, Edward M., of Wadhurst, Sussex, a director of Messrs. Drummond Bros., Limited, machine-tool makers, of Guildford	£316,977

Obituary.

The death occurred at his home at Coatbridge, on October 22, of William Waterston, retired blacksmith, in his 79th year.

Mr. James Lennox, chief chemist at the Blochairn Steel Works of the Steel Company of Scotland, Limited, died after a short illness on October 25. Mr. Lennox had been employed at Blochairn Works for 45 years.

Mr. Frederick William Bull, of Sidmouth Lodge, Newcastle, Staffs, has died at the age of 70. Mr. Bull was associated all his business life with Messrs. Robert Heath & Sons, Biddulph Valley Ironworks, but retired some years ago.

Cost of Corporation Foundry Manufactures.—Investigations have been made by the Expenditure Special Committee of the Manchester Corporation on the cost of manufactured articles produced by the Transport Department. These fall into two main classes, one of which comprises foundry work and miscellaneous spare parts required for motor-buses. Certain figures were supplied by the department as to the cost of foundrywork and spare parts, but, states the Expenditure Special Committee, these in their present form were of no value as a guide to relative costs. No comparisons with private enterprise were available. The general question was examined by the Transport Committee some years ago, and it was then decided, mainly having regard to the general convenience to the department in obtaining its exact requirements more readily and to economies arising from the use of scrap metals, and also as a consequence of failures by contractors in regard to deliveries, that it was advantageous to the department to continue the existing methods. It is understood that the foundry manufactures of the department approximate to an estimated value of £6,000 per annum. When the question of crossings was raised, the Transport Department claimed it could make articles in the foundry as cheaply as private enterprise.

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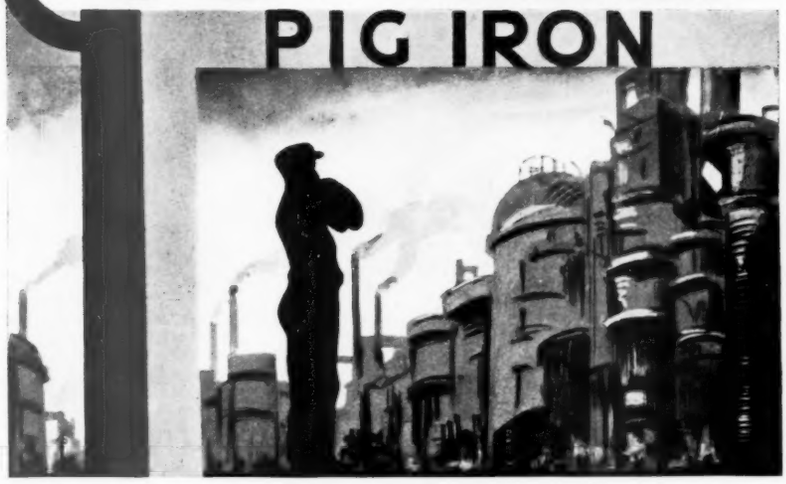

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Perfect combustion under the most exacting conditions is available for your furnaces.

THE highest attainable temperature for heating is obtained with pulverised coal due to the intensive mixing of the correct quantity of air with the fine coal particles, thus ensuring a high rate of heat transfer from the hot gases to the mass to be heated, giving:

1. GREATER OVERALL EFFICIENCY.
2. MORE UNIFORM QUALITY OF PRODUCT.
3. REDUCING THE TIME CYCLE OF OPERATIONS.

These conditions are attainable by the use of a lower grade of fuel at a price appreciably less than that previously used, also in many cases with a greatly reduced staff necessary for controlling combustion conditions. The fullest details of the specific application of the Buell System to your type of plant will be willingly sent on request.

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Works: EDGAR ALLEN & CO., LTD., Imperial Steel Works, Sheffield.

THREE TYPICAL BUELL INSTALLATIONS.

	HAND FIRING.	BUELL P.F. FIRING.
17-TON ANNEALING FURNACE.		
Cost of coal used	22/- *per ton.*	14/9 *per ton.*
Quantity of fuel consumed ..	20 *tons per week.*	11 *tons per week.*
5 - TON ANNEALING FURNACE.		
Cost of coal used	35/- *per ton.*	12/6 *per ton.*
Quantity of fuel consumed per ton of castings	28 *cwts.*	16 *cwts.*
3 - TON ANNEALING FURNACE.		
Cost of coal used	24/4 *per ton.*	11/6 *per ton.*
Coal consumption per ton of castings	39 *cwts.*	29 *cwts.*

The Buell Combustion
49, MOORGATE, LONDON, E.C.2 Co. Ltd

Telephone: Metropolitan 7751.

Raw Material Markets.

Activity is maintained in the iron and steel markets, and prospects for the winter are quite promising. The increased production of many materials, particularly semi-finished steel, is well maintained. As regards pig-iron, good deliveries continue to be taken, especially by the light-castings foundries. Quotations are generally very firm, and upward movements are anticipated in some quarters. Scrap-iron prices are also very firm.

Pig-Iron.

MIDDLESBROUGH.—The production of Cleveland iron is being increased to meet the growing needs of the market. One blast furnace hitherto producing iron for steelmaking has been turned over to Cleveland, and another furnace which has been undergoing reconstruction is to be lit in a week or two. The additional output has already been booked in advance for home consumption, and the market therefore maintains its firm tone. Many buyers are expecting an upward move in prices. The makers, in view of their well-filled order-books, will only accept further forward commitments from their regular customers. Home transactions continue to be governed by the following minimum prices:—No. 1 Cleveland foundry iron, 65s.; No. 3 Cleveland G.M.B., 62s. 6d.; No. 4 foundry and No. 4 forge, 61s. 6d. per ton, delivered Middlesbrough. Consumers on the North-East Coast pay 2s. more to cover the extra cost of carriage, prices delivered Glasgow are 2s. 9d. more and delivered Falkirk threepence per ton less than the Middlesbrough figures.

East Coast hematite prices are now 62s. 6d. per ton for mixed numbers and 63s. for No. 1 quality. Buyers have shown no hesitation in following the rise, realising that it is more than justified by the increasing cost of raw materials. The current output of hematite is being fully absorbed, and orders already on the books ensure the maintenance of this position for some time to come.

LANCASHIRE.—Makers' representatives in this area report slightly more business during the past week or so, with rather better delivery instructions against old commitments. More activity is reported in the light-castings and other branches of the foundry trade, and several of the jobbing foundries are also reported to be doing better. There are still no signs, however, of a return to long-term contracting, but it is hoped that a tendency in this direction may develop shortly. For delivery to users in the Manchester zone, Midland brands of No. 3 iron—Derbyshire and Staffordshire makes—are on offer on the basis of 67s. per ton, with North-East Coast iron quoted at the same figure, Northamptonshire at 65s. 6d., Derbyshire forge at 62s., and Scottish foundry at about 80s. Quotations for East Coast hematite now range from about 76s. 6d. to 77s. per ton, with West Coast makes still on offer at about 80s. 6d., both delivered in the Manchester area.

MIDLANDS.—The situation in the Midlands market is largely unchanged. Many consumers are already covered, and new transactions mostly concern small tonnages. The light-castings trade continues to be well employed, and more activity is reported at a number of general engineering works. Quotations are unchanged at 62s. 6d. per ton for No. 3 Northants and 66s. for Derbyshire, Lincolnshire and North Staffs No. 3, including delivery to Birmingham and Black Country stations and subject to rebate in certain cases. There is no sign yet of any stringency in the supply of No. 3 foundry grade, as appreciable stocks are still held by the furnaces. North-East Coast hematite, delivered this area, is now 78s. 3d. per ton, and Welsh rates will doubtless appreciate similarly. West Coast hematite remains at 84s. 6d. As regards special irons, Scottish No. 3 is quoted at 85s. to 86s. per ton delivered, and other medium-phosphorus irons from 70s. to 80s., with low-phosphorus grades from 80s. to 90s. The demand for Cleveland pig-iron is small, as the makers are now asking more than the Derbyshire rate, *i.e.*, 72s. 6d. per ton. There continues to be a fair demand from particular trades for refined irons, which vary widely, between £5 and £6 15s. per ton delivered this district.

SCOTLAND.—Business in the Scottish pig-iron market fails to show any improvement of note. Activity is fair at most consuming works, the sugar-machinery makers being noticeably busy. The light-castings trade is generally well employed, and has made heavy forward purchases of Middlesbrough iron. Quotations are unchanged. The price of No. 3 Scottish foundry iron remains at the official minimum of 65s. f.o.t. furnace, with 2s. 6d. extra for No. 1. No. 3 Middlesbrough is 62s. 3d. f.o.t. Falkirk and 65s. 3d. f.o.t. Glasgow. Other English irons are obtainable at from 1s. 3d. to 2s. 3d. per ton below these figures.

Coke.

So far the collieries have made no increase in prices of foundry coke, but the prevalent fears of an increase have caused a large amount of forward buying by consumers during the last three or four weeks. Best Durham brands continue to be offered at 36s. to 38s., with inferior grades 2s. 6d. less. Scottish coke is at 38s. 6d. to 40s. and Welsh at 31s. to 45s. per ton, all delivered in the South Staffordshire area.

Steel.

The general tone of the markets has improved, and not only is the home demand, which has been the mainstay of the market for some time, well maintained, but inquiry on export account is more active. In the semi-finished steel department, practically all the British works producing this class of steel are in a good position as regards orders, and can afford to disregard Continental competition. Most of the business coming on the market is placed with British works, although a fair tonnage still goes to the Continent. In the finished steel market more cheerful conditions have ruled than for some time. The orders placed by the Dutch Government for bridge-building requirements, the Chinese orders for railway material and ships, and the possibility of obtaining a share in the Brazilian orders for warships, have helped to create a better tone. The general demand also has been on a good scale.

Sheffield steelmakers have decided to raise the minimum prices of hard and soft basic steel billets and other semi-manufactured basic materials by 5s. per ton.

Scrap.

Reports from the various districts indicate an increasing shortage of supplies of some grades of scrap material coupled with a general hardening of quotations. In the Cleveland area, in particular, there is some concern as to future supplies. There is a consistent demand for cast-iron scrap in the Midlands, the majority of the ironfounders being regularly employed. There is a good turnover on the Scottish market, scrap iron benefiting in the general improvement. Machinery grade is now at 50s. to 51s. 6d. per ton. In South Wales the demand is still rather restricted, and this district is lagging behind the others in this respect. A slight increase in activity at the foundries would soon make a considerable difference to the situation.

Metals.

Copper.—The "standard" quotation recovered towards the end of last week, but has since fallen. The copper market is still far from being in a stable condition. The demand from British consumers has revived slightly, more interest being shown in electrolytic metal. Few works in this country have stocks of any magnitude. While present indications point to a slight increase in consumption in the near future, it must be remembered that the rate of production is also gradually creeping upwards, particularly as regards the African mines. The situation in the United States continues to attract much attention. So far, the efforts of the Administration to induce those interested to submit to the proposed copper code have not met with success. There has been a slight increase in United States quotations for both the domestic and export markets.

The week's prices have been as follow:—

Cash.—Thursday, £33 12s. 6d. to £33 15s.; Friday, £32 18s. 9d. to £33; Monday, £33 3s. 9d. to £33 5s.; Tuesday, £32 16s. 3d. to £32 17s. 6d.; Wednesday, £32 13s. 9d. to £32 15s.

Three Months.—Thursday, £33 16s. 3d. to £33 17s. 6d.; Friday, £33 1s. 3d. to £33 2s. 6d.; Monday, £33 6s. 3d. to £33 7s. 6d.; Tuesday, £32 18s. 9d. to £33; Wednesday, £32 16s. 3d. to £32 17s. 6d.

Tin.—A communiqué was issued following last week's meeting of the International Tin Committee, stating that, from January 1, national tin-export quotas are to be raised from the present level of 33⅓ per cent. to 40 per cent. of the standard tonnages. In addition, there is to be a special quota of 4 per cent. during 1934, from which all excess exports during the period of the agreement now ending are to be deducted. A new scheme for the continuance of control for the next three years has been signed. The scheme makes certain minor adjustments in national "standard" tonnages. The announcement had little effect upon the market, as it was largely as expected, and the effect of the new supplies in 1934 had already been discounted. The larger exports should be well absorbed by the gradually-improving consumption.

Daily quotations:—

Cash.—Thursday, £225 to £225 2s. 6d.; Friday, £224 10s. to £224 12s. 6d.; Monday, £225 5s. to £225 7s. 6d.; Tuesday, £224 10s. to £224 15s.; Wednesday, £224 7s. 6d. to £224 12s. 6d.

Three Months.—Thursday, £224 17s. 6d. to £225; Friday, £224 7s. 6d. to £224 10s.; Monday, £225 2s. 6d. to £225 7s. 6d.; Tuesday, £224 5s. to £224 10s.; Wednesday, £224 2s. 6d. to £224 7s. 6d.

Spelter.—The spelter market fails to show any strength. Consumption is still patchy, both here and on the Continent. The galvanising industry is generally rather under-employed, but brass manufacturers are fairly busy. Consumption in America continues to be good.

Price fluctuations:—

Ordinary.—Thursday, £16; Friday, £16; Monday, £16 2s. 6d.; Tuesday, £15 17s. 6d.; Wednesday, £15 11s. 3d.

Lead.—There has been a decidedly better demand in this country for lead and good sales have been made, report Messrs. Brandeis, Goldschmidt. The industry generally is better occupied, with the exception of the cablemakers, who are still suffering from lack of orders. A strike has occurred at one of the leading mines in Australia, and it would normally have the effect of causing the price to advance. This, however, is counteracted by the heavy stocks and large shipments which are being made, and is therefore not a serious matter at present.

Daily market prices:—

Soft Foreign (Prompt).—Thursday, £12 1s. 3d.; Friday, £11 18s. 9d.; Monday, £11 17s. 6d.; Tuesday, £11 12s. 6d.; Wednesday, £11 13s. 9d.

Giant Cunarder.—"One hesitates to refer to the giant Cunarder lest one should set on foot some new rumour about the fate of that unfortunate vessel," declared Mr. H. A. Reincke, chairman of Messrs. Beardmore & Company, Limited, when addressing Glasgow University Engineering Society recently. No doubt each decision in its turn had been dictated by convincing considerations, but he could not refrain from pointing out to the young engineers of Glasgow what a tragedy it was that our economic situation should have reached such a pass that it was possible, while foreign vessels belonging to debtor nations were entering our ports with blue ribbons flying at their mastheads, that our veteran unemployed who made the Clyde the premier shipbuilding river in the world, and our lads who had not yet had a chance to work should stand in knots in the streets of Clydebank with their hopes for the future slowly ebbing away under the shadow of that monster skeleton of Britain's former maritime greatness. He found it hard to think of a more telling illustration of psychological reactions exercising a baneful influence on resurgent youth. He hoped and prayed that when the helm of the ship of State passed into the hands of the younger generation they would have recovered that economic freedom and independence, the passing of which so sorely aggravated the suffering and retarded the recovery of their troubled world to-day. That freedom would only be recovered when the economic barriers had been removed which had been growing up like mushrooms all over the world in recent years. Everywhere the reaction of these barriers had thrown those seeking shelter behind them on to their own resources and had cut them off from that untrammelled and natural intercourse, which in pre-war days assisted the wheels of trade and industry to revolve smoothly, progressively and profitably.

XUM

Sterling

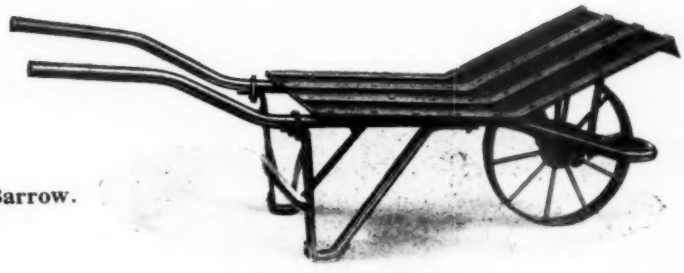
ALL STEEL TUBULAR

WHEELBARROWS

ARE IDEAL FOR ALL FOUNDRY PURPOSES.

THEY POSSESS MANY IMPORTANT ADVANTAGES.

No. 7 General Purpose Barrow.



No. 12 Pig Iron Barrow.

A Sterling Product designed for hard work and built to last.

All parts are standardised and interchangeable for repairs.

Capacities from 2½ to 6 cubic feet.

Write for Booklet W.39.

STERLING FOUNDRY SPECIALTIES LTD.

London Office:
13, VICTORIA STREET, S.W.1.

BEDFORD.

Telephone: 3345 BEDFORD.
Telegrams: "STERFLASK, BEDFORD."
Code: WESTERN UNION.

RAW MATERIALS—PRICE LIST.

(Wednesday, November 1, 1933.)

COPPER.

	£	s.	d.
Standard cash	32	13	9
Three months	32	16	3
Electrolytic	36	10	0
Tough	34	10	0
Best selected	35	0	0
Sheets	64	0	0
India	45	0	0
Wire bars	37	0	0
Ingot bars	37	0	0
H.C. wire rods	39	5	0
Off. av. cash, October	33	13	10 21/24
Do., 3 mths., October	33	17	2 1/24
Do., Sttlmnt., October	33	14	1 11/24
Do., Electro, October	37	7	0 9/12
Do., B.S., October	36	6	4 3/4
Do., wire bars, October	37	14	6 9/12
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			7d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7⅝d.
Wire	7⅝d.
Rolled metal	7½d.
Yellow metal rods	4¾d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN.

	£	s.	d.
Standard cash	224	7	6
Three months	224	2	6
English	225	0	0
Bars	226	15	0
Straits	229	10	0
Australian (nom.)	—		
Eastern	228	15	0
Banca	229	0	0
Off. av. cash, October	223	10	7½
Do., 3 mths., October	223	8	11 3/12
Do., Sttlmt., October	223	10	10 19/24

SPELTER.

	£	s.	d.
Ordinary	15	11	3
Remelted	15	15	0
Hard	13	5	0
Electro 99.9	18	0	0
English	16	7	6
India	15	5	0
Zinc dust	20	0	0
Zinc ashes	3	10	0
Off. aver., October	16	9	1 1/24
Aver. spot, October	16	6	2 7/24

LEAD.

	£	s.	d.
Soft foreign ppt.	11	13	9
Empire	11	17	6
English	13	0	0
Off. average, October	11	19	0¾
Average spot, October	11	16	0 23/24

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	10	0
Do., V.M. ex whse.	24	10	0
Rods	29	10	0

ANTIMONY.

	£	s.	d.	£	s.	d.
English	37	10	0 to	40	0	0
Chinese, ex-whse.				26	15	0
Crude				20	10	0

QUICKSILVER.

	£	s.	d.	£	s.	d.
Quicksilver	9	10	0 to	10	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 10 0
45/50%	£12 10 0
75%	£18 2 6
Ferro-vanadium—	
35 50%	12 8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	5/6 per lb. of Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	2/4 lb.
Tungsten metal powder—	
98/99%	2/7 lb.
Ferro-chrome—	
2/4% car.	£25 10 0
4/6% car.	£21 17 6
6/8% car.	£19 7 6
8/10% car.	£18 17 6
Ferro-chrome—	
Max. 2% car.	£29 15 0
Max. 1% car.	£30 17 6
Max. 0.70% car.	£35 15 0
70% carbon-free	9½d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				2	10	0
Bundled steel and shrngs.	1	17	6 to	2	10	0
Mixed iron and steel	2	5	0 to	2	6	6
Heavy cast iron	2	5	0 to	2	6	6
Good machinery	2	7	6 to	2	10	0
Cleveland—						
Heavy steel				2	7	6
Steel turnings				1	11	6
Cast-iron borings				1	2	0
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	5	0 to	2	7	6
Midlands—						
Light cast-iron scrap	1	18	6 to	2	0	0
Heavy wrought iron				2	10	0
Steel turnings, f.o.r.				1	7	6
Scotland—						
Heavy steel				2	7	6
Ordinary cast iron	2	7	6 to	2	8	0
Engineers' turnings				1	15	0
Cast-iron borings				1	15	0
Wrought-iron piling				2	9	0
Heavy machinery	2	10	0 to	2	11	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	19	10	0
Lead (less usual draft)	11	0	0
Tea lead	8	0	0
Zinc	11	0	0
New aluminium cuttings	73	0	0
Braziery copper	26	0	0
Gunmetal	25	0	0
Hollow pewter	140	0	0
Shaped black pewter	100	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/–
Foundry No. 3	62/6
„ at Falkirk	62/3
„ at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	63/–
Hematite M/Nos., f.o.t.	62/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	115/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/–
„ No. 3 fdry.	66/–
Northants forge	58/6
„ fdry. No. 3	62/6
„ fdry No. 1	65/6
Derbyshire forge	62/–
„ fdry. No. 3	66/–
„ fdry. No. 1	69/–
Scotland—	
Foundry No. 1	67/6
„ No. 3	65/–
Hem. M/Nos. d/d	66/–
Sheffield (d/d district)—	
Derby forge	59/6
„ fdry. No. 3	63/6
Lincs forge	59/6
„ fdry. No. 3	63/6
E.C. hematite	77/–
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/–
Staffs fdry. No. 3	67/–
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/–
Dalzell, No. 3 (special)	102/6 to 105/–
Glengarnock, No. 3	80/–
Clyde, No. 3	80/–
Monkland, No. 3	80/–
Summerlee, No. 3	80/–
Eglinton, No. 3	80/–
Gartsherrie, No. 3	80/–
Shotts, No. 3	80/–

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	0	0 to	9	15	0
Nut and bolt iron	6	15	0 to	7	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				13	5	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.				8	5	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)				7	0	0 & up.
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)	10	10	0 & up.			
Black sheets, 24g. (4-t. lots)				10	5	0
Galv. cor. shts. („)				12	15	0
Galv. flat shts. („)				13	5	0
Galv. fencing wire, 8g. plain				14	0	0
Billets, soft	5	5	0 to	5	12	6
Billets, hard	6	12	6 to	7	2	6
Sheet bars	5	0	0 to	5	5	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11d.
Tubes	15½d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated,

	Dols.
No. 2 foundry, Phila.	18.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	13.50
Basic	18.89
Bessemer	19.76
Malleable	19.39
Grey forge	19.39
Ferro-mang. 80%, seaboard	82.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.74
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.10
Plain wire	2.10
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.65

COKE (at ovens).

Welsh foundry	20/– to 22/6
„ furnace	14/– to 15/–
Durham foundry	21/– to 25/–
„ furnace	15/–
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		16/9 to 17/3
„	28×20	„	33/6 to 34/6
„	20×10	„	24/6 to 24/9
„	18¾×14	„	17/7½ to 17/10½
C.W.	20×14	„	15/3 to 15/6
„	28×20	„	31/6 to 32/–
„	20×10	„	22/6 to 22/9
„	18¾×14	„	15/9 to 16/–

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	6	0	0 to	7	0	0
Bars-hammered, basis	16	0	0 to	16	10	0
Bars and nail-rods, rolled, basis	15	15	0 to	16	0	0
Blooms	10	0	0 to	12	0	0
Keg steel	30	0	0 to	31	0	0
Faggot steel	18	0	0 to	23	0	0
Bars and rods dead soft, st'l	10	0	0 to	12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Oct.	26 ..	33	12	6	inc.	3/9
,,	27 ..	32	18	9	dec.	13/9
,,	30 ..	33	3	9	inc.	5/-
,,	31 ..	32	16	3	dec.	7/6
Nov.	1 ..	32	13	9	,,	2/6

Electrolytic Copper.

		£	s.	d.		
Oct.	26 ..	37	0	0	inc.	10/-
,,	27 ..	37	0	0	No change	
,,	30 ..	36	10	0	dec.	10/-
,,	31 ..	36	10	0	No change	
Nov.	1 ..	36	10	0	,, ,,	

Standard Tin (cash).

		£	s.	d.		
Oct.	26 ..	225	0	0	inc.	22/6
,,	27 ..	224	10	0	dec.	10/-
,,	30 ..	225	5	0	inc.	15/-
,,	31 ..	224	10	0	dec.	15/-
Nov.	1 ..	224	7	6	,,	2/6

Tin (English ingots).

		£	s.	d.		
Oct.	26 ..	225	10	0	inc.	20/-
,,	27 ..	225	0	0	dec.	10/-
,,	30 ..	225	15	0	inc.	15/-
,,	31 ..	225	5	0	dec.	10/-
Nov.	1 ..	225	0	0	,,	5/-

Spelter (ordinary).

		£	s.	d.		
Oct.	26 ..	16	0	0	No change	
,,	27 ..	16	0	0	,, ,,	
,,	30 ..	16	2	6	inc.	2/6
,,	31 ..	15	17	6	dec.	5/-
Nov.	1 ..	15	11	3	,,	6/3

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Oct.	26 ..	18	10	0	No change	
,,	27 ..	18	7	6	dec.	2/6
,,	30 ..	18	10	0	inc.	2/6
,,	31 ..	18	5	0	dec.	5/-
Nov.	1 ..	18	0	0	,,	5/-

Zinc Sheets (English).

		£	s.	d.		
Oct.	26 ..	25	10	0	dec.	5/-
,,	27 ..	25	10	0	No change	
,,	30 ..	25	10	0	,,	,,
,,	31 ..	25	10	0	,,	,,
Nov.	1 ..	25	10	0	,,	,,

Lead (English).

		£	s.	d.		
Oct.	26 ..	13	10	0	inc.	5/-
,,	27 ..	13	5	0	dec.	5/-
,,	30 ..	13	5	0	No change	
,,	31 ..	13	0	0	dec.	5/-
Nov.	1 ..	13	0	0	No change	

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	48 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 6
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4½	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	99 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6½
1924	99 10	97 3½	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2½	81 9	81 9	88 7½
1925	80 4½	78 10½	78 0	78 3	76 0	73 10½	71 7½	69 10½	68 1½	66 7½	66 0	66 10½	72 10½
1926	69 4½	70 0	70 0	70 0	72 6	75 10½	86 7½	90 0	93 10½	117 10	120 0	99 0	86 3
1927	85 0	83 1½	81 0	80 0	73 9	70 0	70 0	68 9	67 6	67 6	66 10½	65 0	73 2½
1928	65 0	65 0	65 6	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	65 0	65 9½
1929	66 0	66 9	67 0	68 1½	69 5	71 10½	72 9	72 6	72 6	72 6	72 6	72 6	70 4½
1930	72 6	72 6	70 0	67 6	67 6	67 6	67 6	64 6	63 6	63 6	63 6	63 6	66 11½
1931	59 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 7
1932	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6
1933*	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	—	—	—

* Delivered Middlesbrough area. Prior to 1933, prices were f.o.t. furnaces.

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